Illinois U Library

Skyways

ANC

Flight Operations • Engineering • Management

FEBRUARY 195

21-5 9-53 NR
UNIV OF ILLINOIS LIBR
CHICAGO UNDERGRAD DIV
AVY PIER
CAGO I

WAYS Round Table:
v Coordination &
Flight Preparation

t's Report:
er Tri-Pacer for
iness Use

Navigation with RMI

Collins communications and navigation equipment is available from selected dealers in every part of the country. Our dealers are completely prepared to install and service Collins equipment in executive aircraft. The quality of their workmanship assures maximum benefits from the design excellence of your Collins equipment.

CONTACT THE COLLINS DEALER NEAREST YOU

CALIFORNIA — Burbank
Qualitron, Inc.
2945 N. Hollywood Way

CALIFORNIA — Los Angeles
Airesearch Aviation Service Co.
5907 W. Imperial Hwy.

COLORADO — Denver
Aircraft Radio & Accessories Co.
Stapleton Airfield

CONNECTICUT — East Hartford
Pratt and Whitney Aircraft
Div. of United Aircraft Corp.
Rentschler Airport

FLORIDA — Hialeah
Aircraft Radio Marine
P.O. Box 325

ILLINOIS — Chicago
Butler Company
Municipal Airport

LOUISIANA — Shreveport
Riley Aircraft Company
423 Crockett Street

MICHIGAN — Ypsilanti
Great Lakes Airmotive, Inc.
Willow Run Airport

MINNESOTA — Minneapolis
Gopher Aeronautical Corp.
Wold-Chamberlain Field

MISSOURI — Kansas City
Aircraft Radio Company
328 Richards Road
Municipal Airport

MISSOURI — St. Louis
Navco (Remmert-Werner)
Lambert Field

NEW JERSEY — Teterboro
Smith-Meeker
Mallard Hangar
Teterboro Airport

NEW YORK — New York
Smith-Meeker Engineering Co.
157 Chambers Street

NEW YORK — Rochester
Page Airways
Rochester Airport

NORTH CAROLINA — Raleigh
Aeronautical Electronics, Inc.
P.O. Box 6043
Raleigh-Durham Airport

OHIO — Akron
Chamberlain Aviation, Inc.
Hangar 1
Municipal Airport

OHIO — Vandalia
Dayton Aviation Radio & Equip. Corp.
Hangar No. 2
Dayton Municipal Airport

OKLAHOMA — Tulsa
Mr. George C. Waller
6922 E. Virgin Street

PENNSYLVANIA — Philadelphia
Interference Research, Inc.
117 S. 46th Street

TEXAS — Dallas
Associated Radio Company
3508 Love Field Drive

TEXAS — Houston
Continental Radio Company
Municipal Airport

ADMA

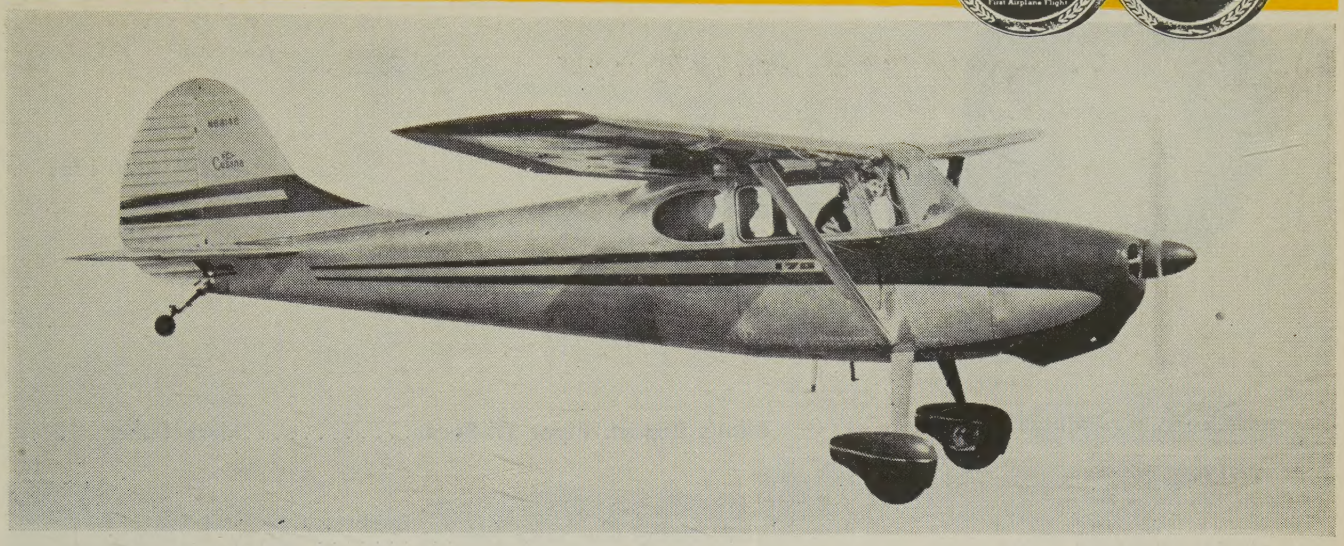
In aviation communications and navigation, it's . . .

COLLINS

COLLINS RADIO COMPANY, Cedar Rapids, Iowa

11 W. 42nd St., NEW YORK 36 **1930 Hi-Line Drive, DALLAS 2** **2700 W. Olive Ave., BURBANK**

NEW "GOLDEN YEAR" CESSNA 170



New Appearance . . . New Performance . . . New Utility for Business

America's Largest-Selling Private Plane

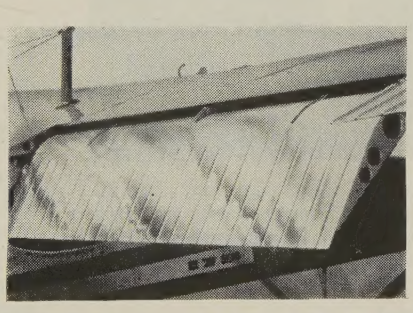
OFFERS EVEN MORE THAN BEFORE!

Already the airplane *the most people* find the most practical for their business and personal needs . . . Cessna's great 170 is now even further improved for Flying's 50th Anniversary Year.

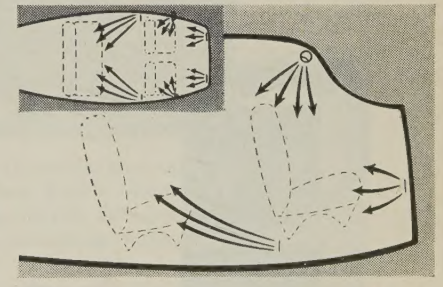
There's *new beauty* in the redesigned cowling, the 1953 striping, the new interiors—*new convenience* in the beautiful new instrument panel with scientifically grouped push buttons, space for more instruments with engineered lighting—*new comfort* in the all-new heating and ventilating system.

And in addition to this the 170 has all of the advantages that made it America's largest-selling personal plane—including a price tag that's still several thousand dollars less than any other 4-place, all-metal plane on the market. Be *sure* to see it. Consult your Classified Telephone directory for the name of your nearest Cessna dealer . . . **or** mail coupon below.

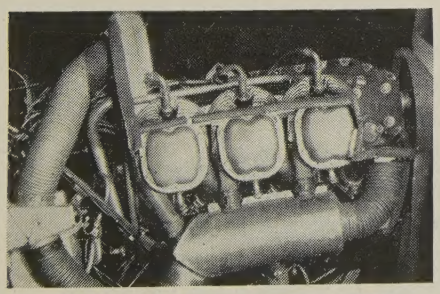
MC CAULEY MET-L-PROP
Now *Standard* Equipment



FULL-RANGE, PARA-LIFT FLAPS
Make Landings Safer!



NEW HEATING & VENTILATING
System . . . Living-Room Comfort!



SERVICED-PROVED, 6-CYLINDER
145-H.P. Continental Engine

BEAUTIFUL NEW INTERIORS
Plenty of Room for 4

Cessna 170

Cessna Aircraft Company
Dept. S-1
Wichita, Kansas

Please send information on the new Golden Year Cessna 170 ____; 190 Series ____. I am interested in a Cessna for business ____ farming ____ other ____

Name _____

Address _____

City _____ State _____

Skyways

FEBRUARY 1953

Flight Operations • Engineering • Management

FOUNDED BY J. FRED HENRY, 1942

PUBLISHER
Mrs. J. Fred Henry

ASSISTANT PUBLISHER
Bennett H. Horchler

MANAGING EDITOR
D. N. Ahnstrom

WESTERN EDITOR
Don Downie

ART DIRECTOR
P. Nowell Yamren

PRODUCTION MANAGER
Stanley M. Cook

ADVERTISING MANAGER
John Young, Jr.

READER SERVICE MANAGER
Edward H. Allen

WEST COAST MANAGER
Gordon Simpson

COVER: This executive DC-3, bearing the seal of Mexico, is used by its President. It was formerly owned by Mexico's baseball magnate, George Pasquel.

MEMBER AUDIT BUREAU OF CIRCULATIONS

SKYWAYS is the official publication of the Corporation Aircraft Owners Association.

Pilot's Report: Piper Tri-Pacer.....Herb Fisher 10

VHF Navigation with RMI.....Harvey A. Senior 13

Work Plane of the North.....James Joseph 16

C-46 plus Jet Pod.....Paul W. Miller 19

Weight & Balance Control.....Fred E. Hyatt, Jr. 21

Flight Operations Round Table: Crew Coordination and Pre-Flight Preparation..... 22

Mail Circuit by 'Copter..... 26

Skyways for Business..... 28

Performance Pitfalls..... 32

Air Your Views..... 6 **CAOA News**..... 30

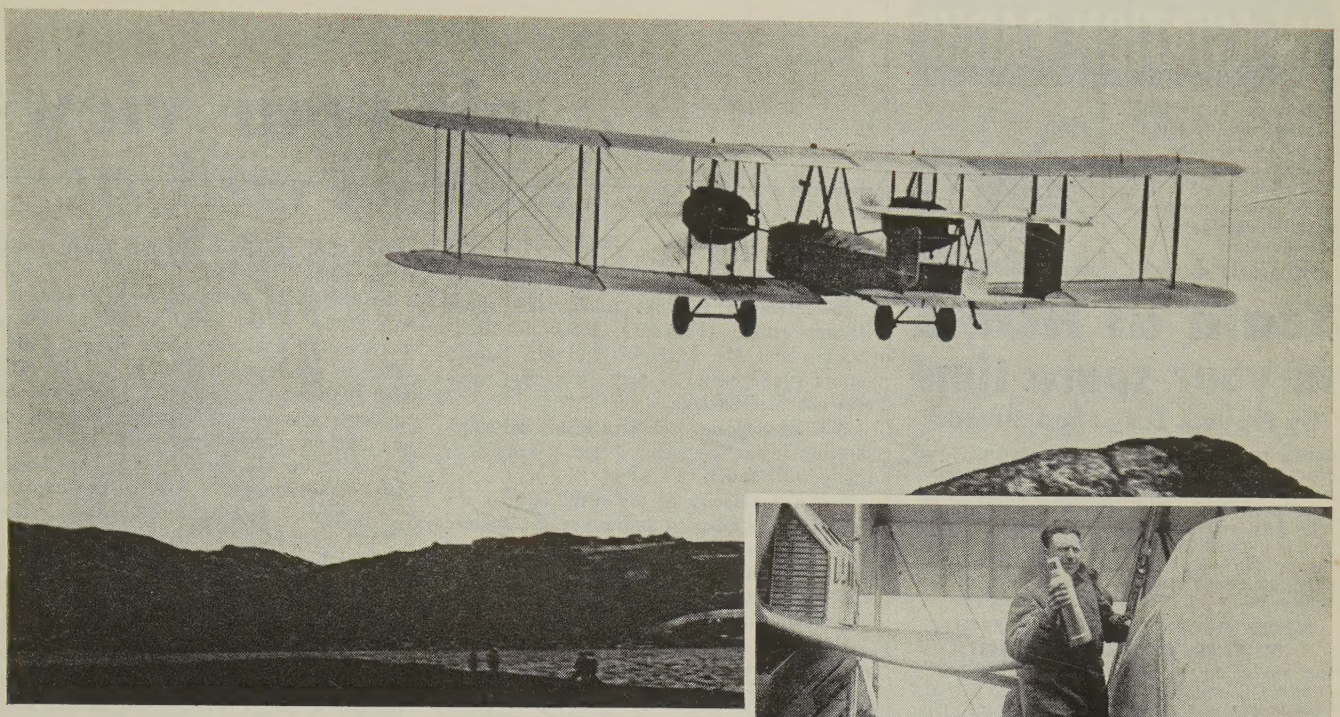
In This Issue..... 9 **Navicom**..... 61

VOLUME 12, NUMBER 2

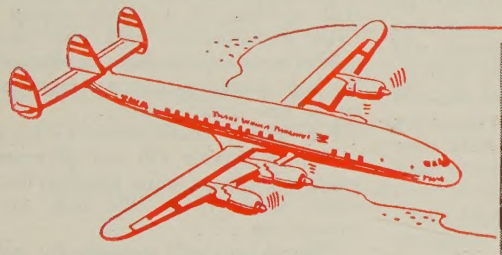
SKYWAYS is published monthly by Henry Publishing Co., 444 Madison Ave., New York 22, N. Y. Advertising Offices: 444 Madison Ave., New York 22, N. Y.; 230 E. Ohio St., Chicago 11, Ill., 816 W. 5th Street, Los Angeles 17, Calif. Gordon Simpson, West Coast Mgr. Allen & Rutherford, Mid-West Reps. Printed in U.S.A. Subscription Prices: U. S. possessions, Canada and Pan-Am. Union $9.00 for 3 years, $7.00 for 2 years, $4.00 for 1 year; all other countries add $1.50 per year for postage. Six weeks required for address changes (give both old and new). Manuscripts, drawings, other material must be accompanied by stamped, self-addressed envelope. SKYWAYS is not responsible for unsolicited materials. Reentered as second-class matter April 16, 1948, at the post office at New York, N. Y., under the act of March 3, 1879.

Copyright 1953 by Henry Publishing Co. The following publications are combined with SKYWAYS: Air News and Flying Sportsman. All rights to these names are reserved by Henry Publishing Co.

First Non-Stop Trans-Atlantic Flight—1919



Captain John Alcock and Lieut. Arthur Whitten Brown, British Army Officers, hold the honor for first flying the Atlantic non-stop. Taking off from St. Johns, Newfoundland, they traveled 1,960 miles in 16 hours and 12 minutes. "We had a terrible journey and wonder we are here at all," records Alcock. "We scarcely saw sun, moon or stars."



Smooth, luxurious comfort sums up the service trans-Atlantic travelers receive today! And at New York's International Airport, alone, over 2,300 overseas arrivals and departures are registered each month, by U. S. and foreign airlines.

Yesterday's miracles in aviation are now daily occurrences! And along with this remarkable story of engineering progress the improvement in petroleum runs parallel.

Phillips Petroleum Company, pioneer in the field of special aviation gasolines, has long been one of the country's largest suppliers of aviation fuels for commercial and military use. Today Phillips is ready with new fuels for the very latest turbo-props and jets, while the company's tremendous capacity for producing 115/145 grade aviation gasoline is still increasing.

When you want dependable aviation products, rely on Phillips . . . first choice of many where performance counts!

AVIATION DIVISION
PHILLIPS PETROLEUM COMPANY
BARTLESVILLE, OKLAHOMA

Phillips 66

AVIATION PRODUCTS

1903 50TH ANNIVERSARY OF THE AIRPLANE 1953

EARN BIG MONEY IN AVIATION RADIO

- Airlines radio technician
- Aircraft radio inspector
- Air Force technician
- Airport radio maintenance technician
- Traffic control operator
- Aircraft manufacturer
- Radio expert

AND MANY MORE

Train at *HOME* in your spare time

by Proved, Easy Shop Method

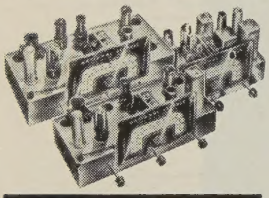
HERE'S YOUR CHANCE for big pay, security, success! Never before such opportunities in *every* field of aviation radio. The airlines need you! The airports need you! The aircraft and radio industries need you! NOW! TODAY! But they need you as a TRAINED man. See how quickly, thoroughly YOU can be trained. How you, too, can enjoy the money you've always dreamed of. Mail coupon below AT ONCE. No obligation.

FAMOUS NATIONAL SCHOOLS OF LOS ANGELES TRAINS YOU RIGHT AT HOME... FAST!

For almost 50 years National Schools has been a large, world-famous *resident* school ...fully staffed, fully equipped. It has trained thousands of young men for successful careers. Now you, too, can enjoy the benefits of this *proved*, shop method training *right at home*, in your spare time. Imagine! World famous training from the world's aviation capitol *without moving a step from your door!* Get *all* the facts. Mail coupon TODAY!

NATIONAL SCHOOLS' WELFARE DEPARTMENT helps you with your technical and personal problems. Gives you the benefit of its wide industry contacts and experience after graduation.

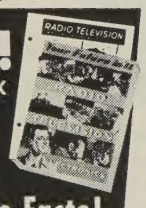
YOU GET ALL THIS EQUIPMENT... NO EXTRA COST!



You learn by *doing*... You build this modern super-het with equipment we send you including tubes.

—added feature, this factory-made Professional Multi-Tester. It's yours!

FREE! BIG BOOK AND SAMPLE LESSON



Get the Facts!

DRAFT AGE? National Schools training in radio-TV helps you get into special service classifications. Higher pay, grades!

APPROVED FOR G.I. TRAINING

NATIONAL SCHOOLS

Los Angeles, California • Established 1905
In Canada: 193 E. Hastings St., Vancouver 4, B.C.

SEND NO MONEY! MAIL TODAY!

NATIONAL SCHOOLS, Dept. RAP-25
4000 South Figueroa Street
Los Angeles 37, California

Mail in envelope or paste on postal card

Mail me FREE book "My Future in Radio-Television and Electronics," and FREE sample lesson.

NAME_____ AGE____

ADDRESS_____

CITY_____ ZONE____ STATE_____

☐ VETS! Check here if you are a veteran.

. . . air your views

More Stall Talk

Gentlemen:

In reference to that much-talked-about Dilbert article (February, 1952) in SKYWAYS, and Mr. Keough's and Mr. Saint's letters (June issue), I agree with Mr. Saint and not Mr. Keough.

Will an airplane stall if a headwind stops blowing instantaneously? I say it very definitely will, and here's when:

1. When velocity of the wind is zero, an aircraft's groundspeed and airspeed coincide. Therefore, you could say that the stalling speed of the aircraft is 65 mph indicated airspeed or 65 mph groundspeed when there is a dead calm existing.

Now let's say an aircraft is flying into a 65-mph headwind and is indicating 75 mph, leaving a 10-mph groundspeed. The stalling speed of the aircraft is 65 mph indicated. For further exaggeration to prove a point, let's say it takes this airplane 30 seconds to accelerate from 10 mph to 65 mph indicated airspeed under a no-wind condition before it has passed its stalling speed and can become airborne.

If the headwind stops instantaneously (an impossible condition), then airspeed and groundspeed coincide and the aircraft will have only 10 mph forward speed (call it groundspeed or airspeed, as you desire). Immediately from this point forward, for the 30 seconds required to accelerate from 10 mph to 65 mph, you will have a stall condition.

2. Put a radio-controlled free flight model in a wind tunnel. Under normal conditions it takes the model 10 seconds to accelerate from 0 to 70 mph. The velocity of the wind tunnel is maintained at 70 mph. Therefore, in relation to the tunnel walls the model is not moving. Now let's shut a large door and instantly cut the wind tunnel velocity to 0. What happens to the model? It is below stalling speed for the 10 seconds it takes to accelerate from 0 through 70 mph.

In these two examples, the speeds to regain flight would, of course, have to be a shade over the stalling speeds cited.

3. Did you ever see a lightplane flying at a tiedown during a wind storm? If you would check the airspeed indicator, it might be indicating erratically between 30 mph and 65 mph. At certain points the aircraft is "flying" and off the ground. But did you ever see the aircraft lunge forward at the tiedowns when the gust velocity dropped and allowed the plane to drop back to the ground? Preposterous! To believe Mr. Keough, the plane would have enough kinetic energy in the mass to cause forward motion while expending the energy.

4. Ever hear of stalling out on take-offs and landings during extremely gusty conditions? If you've done any flying at all, you've undoubtedly experienced it to some extent, but possibly without much thought as to what happened.

Sudden wind shifts of high velocities as experienced in line squalls have caused numerous stall accidents. The elapsed time it takes to accelerate and make up the difference of a strong headwind subtracted and suddenly changed to a tail wind may not be sufficient at a low airspeed and low altitude to allow recovery. If you don't believe it, I suggest you talk to some airline captains. You'll have a tough time convincing them it can't happen.

Theoretically, there is no such thing as wind once you are in free flight and not in contact with the ground.

For such stalling to occur, however, the headwind must be of sufficient velocity that when it is instantaneously subtracted, the indicated airspeed is below the stalling speed of the aircraft. The elapsed time of the momentary stall condition would vary largely with the stalling speed of the plane, the rate of acceleration coupled with the altitude and power settings, the temperature and other factors.

The Air Force once diagnosed an apparent stall accident of a highly loaded fighter (with a subsequent high stall factor) as sudden or abrupt changes in direction during high wind velocities accompanying frontal or line squall activity.

For further confirmation as to whether or not an aircraft will stall if a very high velocity headwind quits blowing instantaneously, write NACA. We did. And their answer was . . .

"The aircraft will momentarily stall while accelerating to and above flying speed."

B. FRITS

Pilot, Eastern Air Lines
Atlanta, Ga.

Gentlemen:

Since when is stall speed dependent on wind?

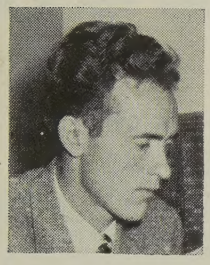
An aircraft creates its own relative wind when it's off the ground, and actual wind only affects its track and groundspeed. This is the same old story—groundspeed confused with airspeed. If what they say is true, I'm going to be at an airport on gusty days to watch the accidents. True, the wind may just die down, but watch a wind-force indicator on a gusty day. The gusts die down faster than a man can react and faster than an aircraft can change for these reactions. If the wind should die down while a plane is on its final approach, the only change will be the touchdown point.

JAMES WICKERT, USNR

Milwaukee, Wis.

. . . and the battle goes on and on and on and so forth. We wonder what the bumblebee'd say about all this.—Ed.

in this issue...



Paul Miller, Chief Engineer of The Flying Tiger Line and author of the article, "C-46 with Jet Pod," is a former Navy fighter pilot and a crop duster of no mean reputation. He has the distinction of having flown 2200 hours in crop dusters in Nevada and Oregon without scratching an airplane. "We knocked down a few power lines and fences," he says, "but that doesn't count." Paul joined The Flying Tiger Line in 1948 and, as Chief Engineer, has flown copilot on all experimental test flights. His search for a weight-saving, efficient powerplant to assist the C-46 has been going on ever since he joined the F-T's. Mr. Miller's work has been of prime importance since a single pound saved, or added to allowable payload, is worth some $4,000 to his company during a full year of operation of a plane that is on the line constantly.

Paul Miller has over 5200 hours of flying time.

▸ According to reports, Jim Joseph and his photographer who went up into Canada and Alaska for the "Work Plane of the North" article, have finally thawed out. Despite "difficult and trying conditions," the boys nailed down a good example of the de Havilland Beaver's utility.

▸ During this month's Round Table discussion at the Wings Club in New York, one of the participants suggested that pilots who've had near-accidents report such incidents and explain what they did to avoid the accident's becoming real. Such reports, the attending pilots agreed, would do much to help other pilots in their operations and would also help in the development of aids to overcome accidents and near-accidents. This we all want to do. Therefore, you pilots who have had near-accidents or have experienced near-misses, please write us the details. We will not print your name, unless you specifically want it printed; in fact, you need not even sign your "report." Just give us the incident details . . . and help us to help you and other pilots overcome this condition.

▸ Veteran test pilot Herb Fisher, who flies evaluation flights for SKYWAYS in between chores as head of the Aviation Development Section of the Port of New York Authority, got such a boot out of flying the new Piper *Tri-Pacer* he tracked the ship down again and took four-year-old Herbie Jr. for a ride . . . all of which adds to the youngster's already imposing number of hours in the air. Herbie Jr. is probably entitled to the "Lad of Distinction" designation, inasmuch as he's already flown faster than most professional pilots. When Herb was doing high-speed test work for Curtiss-Wright, he one day took the boy along for the ride.

Fred E. Hyatt, author of "Weight and Balance Control," is Chief Weight Engineer for Republic Aviation Corp. Mr. Hyatt has been in this type of work for 16 years. He graduated from Worcester Polytechnic Institute in 1936 with a BS in Aeronautical Engineering, and immediately went to work in the Weight Section of Chance Vought Aircraft. He joined Republic in 1940 and became Chief Weight Engineer in 1943. Mr. Hyatt currently is president of the Society of Aeronautical Weight Engineers.

▸ Next Issue: ALPA Representative and Braniff Air Lines' pilot Capt. L. Homer Mouden details the Convair 340, one of the newest air transports going into scheduled airline service. His evaluation highlights its flight operation.

executive pilot's report

businessman's TRI-PACER

Piper produces new model Tri-Pacer to meet needs of the salesman, rancher or the small-business executive

by Hugh Fisher

Chief, Aviation Development, Port of N. Y. Authority

In one of my recent check-pilot reports for SKYWAYS, I listed as a major problem among aircraft users in business and industry the temporary lack of equipment designed to meet all of their particular operating requirements.

However, this need for additional types of airplanes does not extend to the field of single-engine, two- and four-place aircraft. Single-engine planes available to the businessman-flyer and to small corporations which cannot use multi-engine types are uniformly excellent and there are enough of them to fit almost any purse or purpose.

One of the newest and best of these single-engine aircraft is the 1953 model of Piper's four-place *Tri-Pacer* with the 135-hp four-cylinder Lycoming engine, which also powers the three-point gear *Pacer*.

I flew one of Bill Piper's first open-cockpit *Cubs* many years ago and have piloted or been a passenger in several of his aircraft since that "Model T" era, but I was pleasantly surprised at what I found in this trim *Tri-Pacer*. It represents a new high level of lightplane engineering and provides the handling qualities, comfort and styling found most often in heavier and more expensive four-place equipment. And another big plus in its favor is that tricycle gear, for landing and ground handling.

We got a quick line on the *Tri-Pacer's* take-off performance when we left Teterboro Airport for this evaluation flight. We wheeled away from the Safair hangar with a full load of gas, the seats occupied by four men who aren't diet conscious, a lot of photographic equipment, topcoats and briefcases—a load that pushed us right up close to the allowable gross of 1,950 pounds. That's a new gross, made possible by an increase of 10 hp over the 1952 model. It is gratifying to report that just about all of the 150-pound increase in the gross is reflected in higher useful load. For the *Tri-Pacer*, the new useful load is 910 lbs. and for the *Pacer* it is 945 lbs.

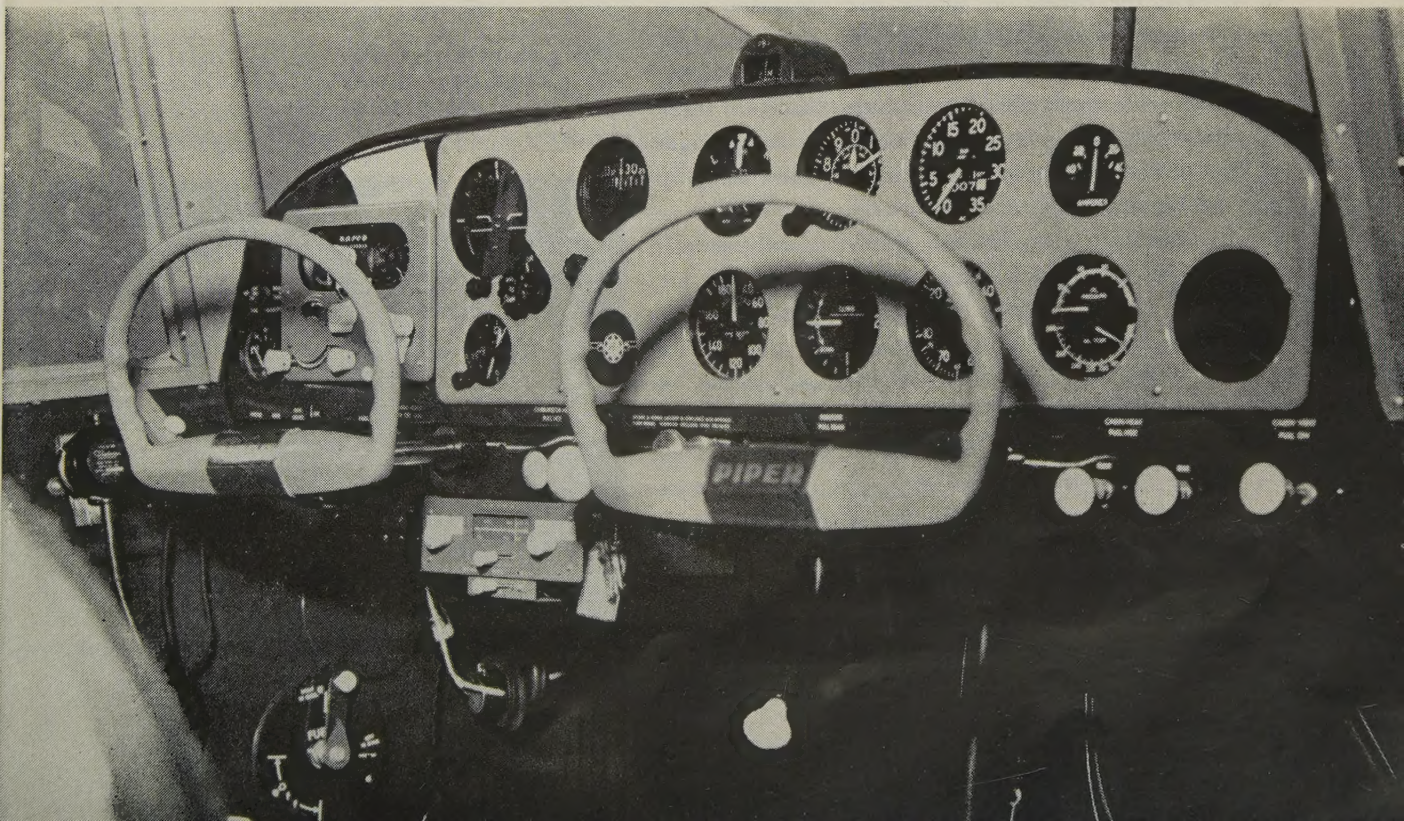
With that Lycoming 0-290-D2 delivering around 2600 rpm, we came off Teterboro at around 65 mph with no sign of vibration or laboring, and climbed away to set a course for Morristown, N. J. With that gross, our climb-out speed was in the neighborhood of 85 mph.

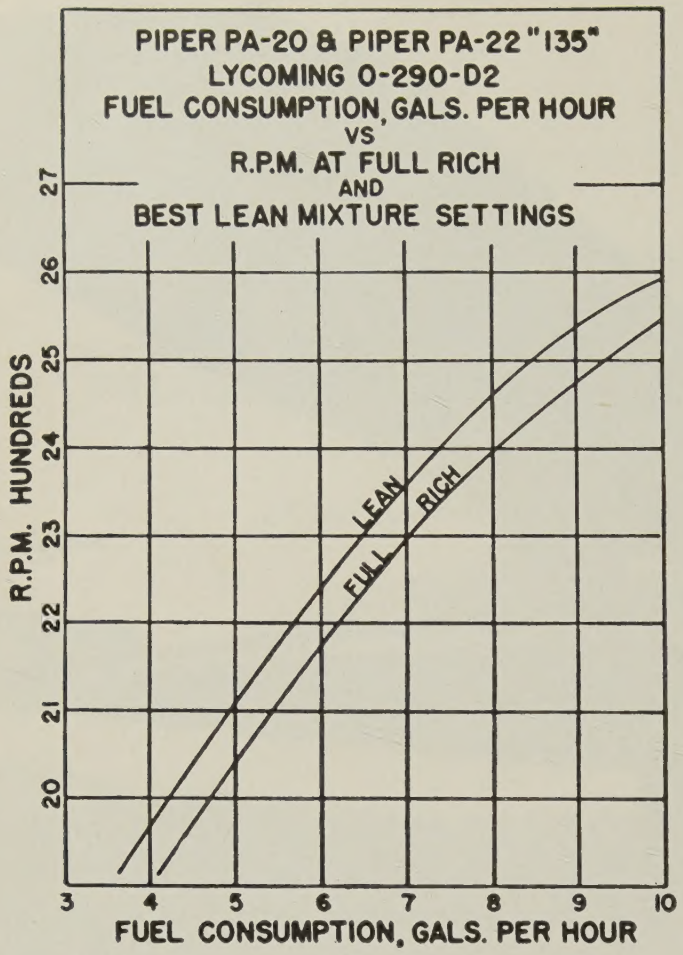
Because of weather conditions, I had no opportunity to check the *Tri-Pacer* at 7,000 feet, its best cruising altitude, but she showed about 122 mph at 75% of power at our low altitude.

Right here I'd like to announce, for the benefit of the few skeptics still left, that the *Tri-Pacer* is one of the easiest airplanes to fly. Bill Strohmeier, who beats a good drum for Piper, says he can

TRICYCLE GEAR *simplifies Tri-Pacer's (above) take-off and landing, improves visibility for taxiing and plane's safety factor in gusty wind conditions. Cruise-stop on throttle provides consistent power setting at optimum cruise altitude*

INSTRUMENT PANEL *(below) is designed to accommodate any normal grouping of instruments from basic engine and flight through advanced gyro instruments, by interchanging panel cover plates and one insert plate on PA-22's main panel*





document that statement with records of many who have soloed after a day of instruction.

For the benefit of almost any lightplane user, such as the salesman, the business executive, pipeline patrol and survey company, the farmer or the man who simply flies for pleasure, there are three improvements today in aircraft design and navigational facilities which make the lightplane a highly practical method of transportation.

One is the tricycle gear, since it greatly simplifies take-offs and landings, improves visibility for taxiing and improves the safety factor in gusty wind conditions. Another is simplified controls, *i.e.* the interconnection between rudder and aileron on the *Tri-Pacer*. These interconnected controls permit the plane to be flown with rudder or wheel alone. Piper also has simplified ground steering by connecting rudder pedals directly to the nose wheel.

Next to the tricycle gear and simplified controls and ranking right with them in contributing to safer, more practical flying is the nation-wide omnidirectional range system of navigation. It is an electronic highway that takes a pilot to his destination and it is as simple to operate as a home radio set. With omni, the pilot's chances of getting lost are greatly minimized.

Another attractive feature of the *Tri-Pacer* is the cruise-stop incorporated in the throttle mechanism to provide consistent power settings below the 7,000-foot optimum cruising altitude. In addition to giving the pilot power settings without reference to the tachometer, the cruise-stop provides a more or less fixed rpm. Variations from that rpm would indicate the possible presence of ice or other causes of engine malfunctioning.

The cruise-stop is set to give 75% of power under normal operating conditions at low altitudes. When a predetermined higher or lower power setting is desired, it can be obtained by removing or installing small spaces in the throttle friction lock.

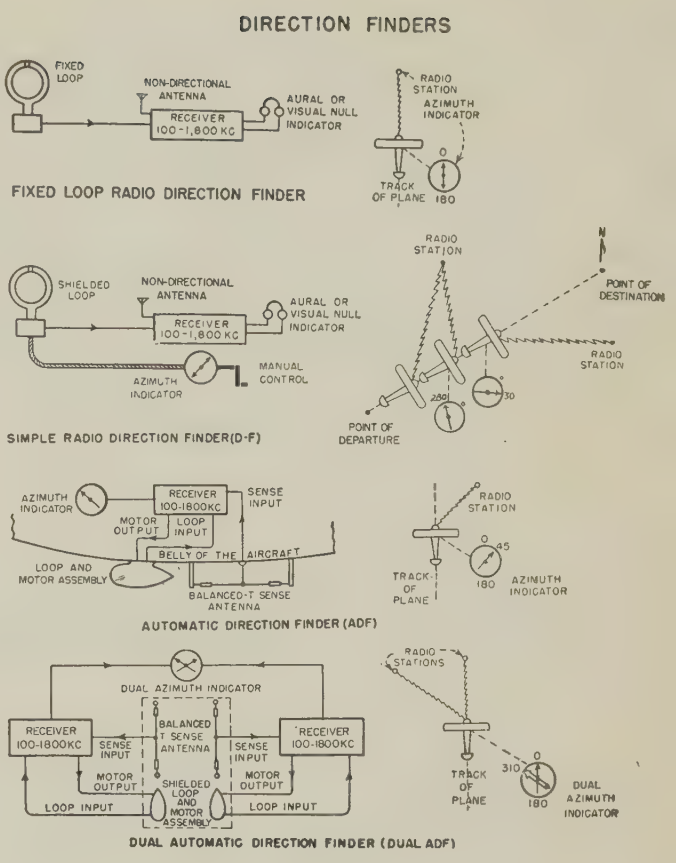
Aircraft manufacturers, logically, have been against excessive placarding of cockpits, but I believe the *Tri-Pacer* could stand just one more pasted under the window on the left-hand side and pointing in the general direction of the master switch and the starter button. They are in a handy location because all you have to do is to reach under the lower left corner of the pilot's seat to get at them. But to the pilot unfamiliar with the airplane, they are well concealed.

Also, I found the altimeter in the *Tri-Pacer* very confusing and I am sure the average lightplane pilot would have the same reaction. The instrument itself can be read easily but cannot be interpreted at a quick glance. I am (*Continued on page 54*)

PIPER REPRESENTATIVE *Bill Strohmeier (right) directs veteran test pilot Herb Fisher's attention to 13-plate oil radiator in nose cowl. Radiator assures adequate cooling under severe heat conditions; baffle is available for winter*

VHF Navigation with RMI

by Harvey A. Senior



DIRECTION FINDERS *use either fixed or rotatable loops. The fixed type is mainly for homing; rotatable for positioning*

To the pilot on a cross-country flight, it is of paramount importance that he maintain the level-flight attitude of his airplane within reasonable limits. Next, he must be aware of his geographic location at all times so that he may navigate from point of departure to point of destination. The first-mentioned condition is obtainable by reference to the horizon and to other check points outside the flight compartment when flying contact, and by reference to the several attitude instruments inside the flight compartment during times of restricted visibility. Location information during VFR is obtained largely by reference to various landmarks, otherwise this data is furnished by the navigational instruments within the flight compartment.

Early efforts to determine position by means other than visual check points were based upon characteristics of the loop antenna and the utilization of radio stations as fixed ground points—in brief, radio direction finding. Equipment for this purpose consisted of a radio receiver, a fixed loop antenna, a non-directional antenna, and a pair of earphones.

A loop receiving antenna, supported vertically, gives maximum reception when the plane of the loop is in line with the transmitting station. As the loop is rotated from this position, volume gradually decreases, reaching a minimum (null) when the plane of the loop is perpendicular to a line from the station. As rotation is continued, volume gradually increases and again reaches a maximum value when the plane of the loop is once more in line with the radio station. Two nulls and two areas of maximum signal are obtained during a 360° rotation of the loop.

The exact position of the loop giving a *minimum* signal is much easier to determine than determining the exact position of the loop at which a *maximum* signal is received. Consequently, in using the loop antenna for direction finding, the point of minimum reception (null) is sought rather than the point of maximum reception.

Homing via DF

The fixed-loop type of direction finder is used mainly for "homing" or flying directly toward a ground radio station comprising a low-frequency range, compass locator, broadcast or other station operating within the frequency range of 100 to 1800 kc. The loop antenna is in no way rotatable but is secured to structure on the fore and aft centerline of the aircraft, either on top or beneath the fuselage,

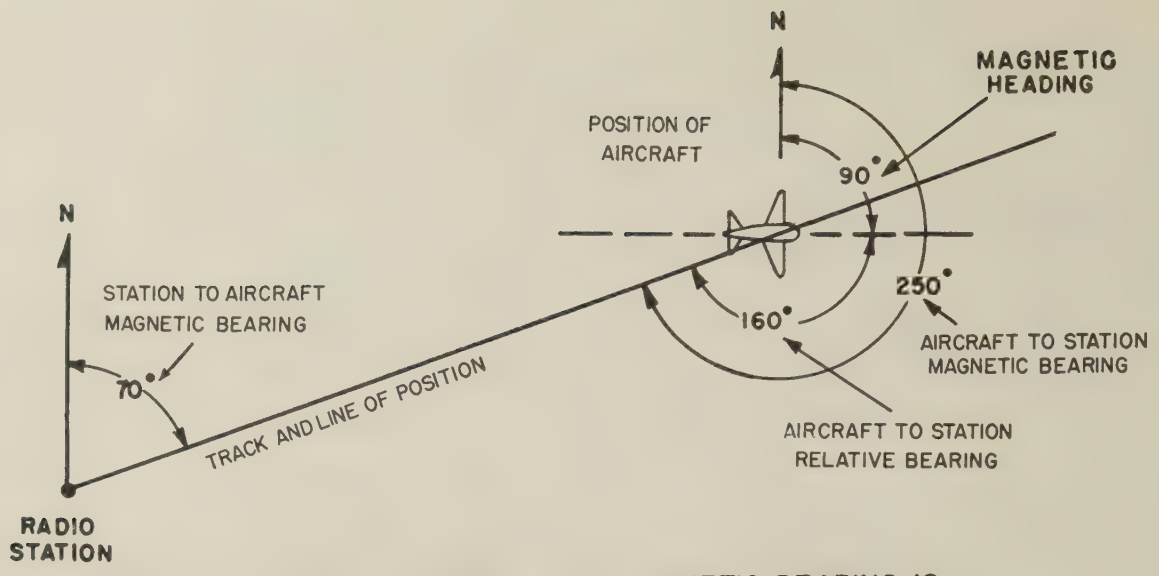


FIGURE 1 DIAGRAM SHOWING HOW MAGNETIC BEARING IS OBTAINED FROM RELATIVE BEARING AND HEADING

in such manner that the plane of the loop is parallel to the wing span. In other words, the hole in the loop antenna points toward the nose of the airplane, and an "aural null" will be received when the radio station is directly ahead of or behind the aircraft.

In order to "home" or fly directly toward a station, the pilot first tunes in the station while using the non-directional antenna. He then switches to the loop antenna and turns the aircraft until an aural null is obtained. Upon receiving this indication, the pilot knows definitely that the station being received is on a line perpendicular to the plane of the loop, but whether the station is ahead of or behind the aircraft is not known. This is referred to as the 180° ambiguity characteristic of a loop antenna. In order to resolve this 180° ambiguity, the pilot must perform a prescribed maneuver to establish his line of position relative to the radio transmitting station. He turns the plane so as to receive the null from dead ahead and proceeds to fly directly toward the station. An improvement made on this set was the addition of a "left-right" indicator which simplified the problem of the 180° ambiguity and provided a visual reference for the pilot to follow.

The next advancement was the substitution of a rotatable loop for the fixed loop. It is much simpler to turn a loop relative to the airplane than to turn the airplane (with the loop attached) relative to the radio station. Of course, the desired result will be obtained in either case. Equipment for this purpose consists of a radio receiver, a hand-operated rotatable loop antenna having a fixed azimuth scale conveniently located in the plane's cockpit, a non-directional antenna, and a pair of earphones. The loop antenna is mounted so as to be directly accessible to the pilot or is mounted at a remote location with mechanical means for rotation by the pilot. The azimuth scale is calibrated in degrees, and zero of the scale normally is aligned with the longitudinal axis of the airplane, facing toward the nose. A pointer affixed to the antenna, at a point perpendicular to the plane of the loop, then indicates loop position in relation to airplane heading. Pointer on zero thus furnishes loop position as for the fixed-loop antenna.

There are two general methods of use for the radio direction finder (DF) with rotatable loop: 1) to "home" on a radio station and, 2) to determine position by taking cross bearings. In order to "home," the pilot first tunes in and identifies the desired station while using the non-directional antenna. He then switches to the loop antenna and rotates the loop through the first null and then through the second null. This gives the line of direction of the signal, with the attendant problem of resolving 180° ambiguity. The pilot then performs a prescribed maneuver to establish his line of position relative to the radio station, turns the loop to read zero on the azimuth scale (plane of the loop parallel to wing span), and turns the plane toward the station until airplane heading coincides with null indication. He is then flying directly toward or "homing on" the radio station.

Positioning Along Course

To establish geographic position or to monitor progress when flying a compass course, it is necessary to take radio cross-bearings, *i.e.*, relative bearing from the aircraft to at least two radio stations. The desired course line is plotted on a map from point of departure to point of destination, and the magnetic heading of the course line is determined. Once aloft, the pilot steadies down on the designated compass heading. Choosing radio stations to the right and to the left of the course line, and starting with the loop pointer on zero, the pilot turns the loop until a null is obtained while listening to the station to the left of course. Loop pointer position is then read against the azimuth scale. A similar procedure is followed for the station to the right of course. Each scale indication is the angle measured clockwise from the nose of the aircraft to a line drawn from the aircraft to the radio station and is known as the relative bearing from aircraft to station.

Interference by wings, engines, and other parts of the aircraft may cause distortion of the radio waves striking the loop and thus create an error in the indicated relative bearing. The error caused by these factors is known as "quadrantal error," which is to say, radio compass deviation. Correction of quadrantal error is obtained by applying calibration data, obtained at time of equipment installation, to the radio bearing.

To determine airplane position along the course line, a line is drawn on the map from the first radio station so as to intersect the course line at the angle determined by the respective relative bearing from aircraft to station. A similar procedure is followed while using the second radio station and its respective relative bearing. The airplane location is close to where the bearing lines cross the course line. In the cited example, stations to right and to left of course were chosen in the interest of clearness. Stations on the same side of course may be utilized in a similar manner.

Appreciable time is consumed in identifying a station, obtaining its relative bearing, applying quadrantal correction, and in plotting the bearing line on the map. The plane travels an appreciable distance, proportional to cruising speed, along the course line during this procedure. Accordingly, the pilot never knows where he "is," but rather, only knows where he "was." It is apparent that as cruising speeds increase, the "is-was" error becomes greater.

It is well to note that the method of plotting cross-bearings outlined (*Continued on page 46*)

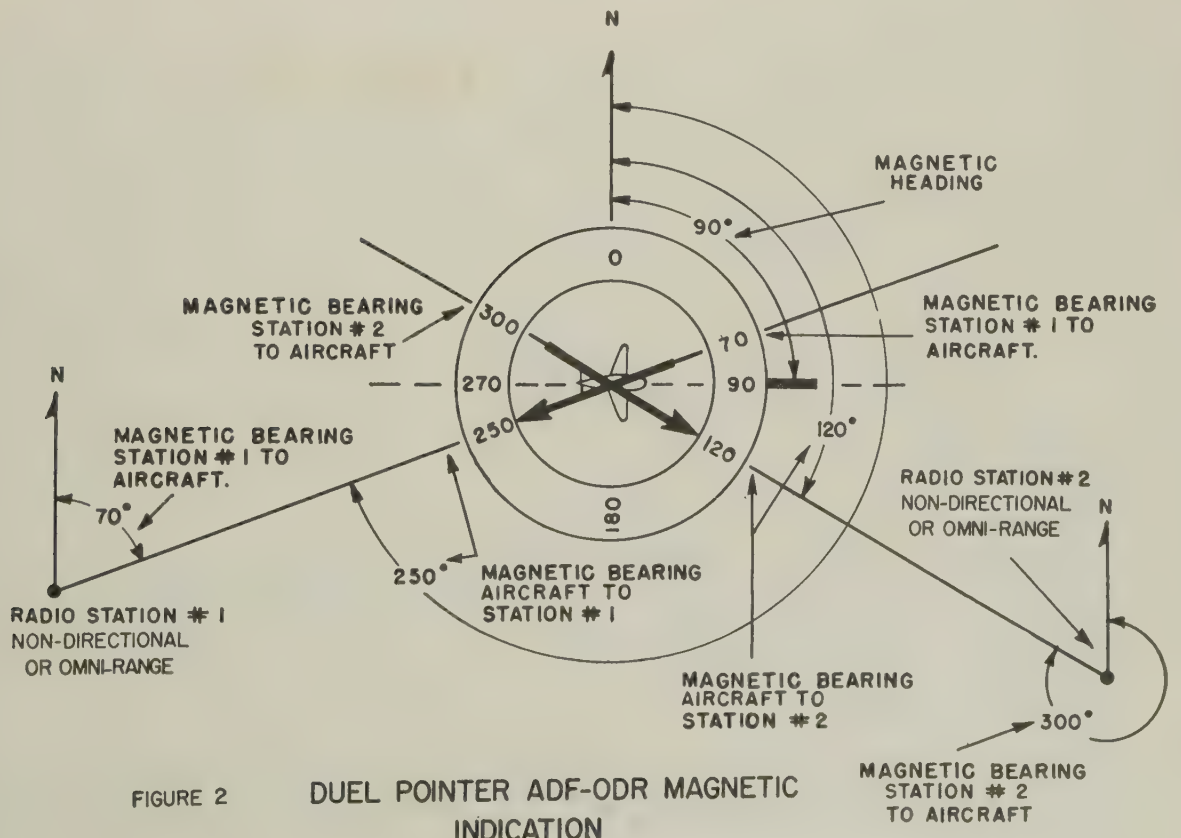


FIGURE 2 DUEL POINTER ADF-ODR MAGNETIC INDICATION

WORK PLANE OF THE NORTH

By James Joseph

During one hectic day last spring, bush-pilot Dick Cull mushed his ski-rigged de Havilland *Beaver* down upon a soggy, treacherous strip in northern Alberta's thawing muskeg. He delivered an oil company executive, gased up, took on a load of grub from a nearby cache, and pulled himself airborne by his boot straps. An hour later he air-dropped food to a stranded oil seismology crew 80 miles away. Then, turning southwest, he came in low over the frozen tundra until he spotted a surveying party and its disabled half-track. As the crewmen waved encouragement, Cull kicked a heavily wrapped shock spring into the atmosphere and watched as it embedded itself in a snowbank a few feet from the vehicle. An hour later he bounced down upon the muddy Peace River, Alberta, airport.

Although he'd already flown something like 500 miles that day, Cull was refueled 15 minutes later and on his way again. With the compass needle nudging north-northeast, he climbed to 3500 ft. and headed back over the bleak, unfriendly solitude of Canada's Arctic.

To Dick Cull and a score of weather-wise veterans of the Canadian bush, such work-horse flying has been routine during the past three years. For bush pilots have become the behind-the-scene prime-movers keeping anywhere from 50 to 70 oil exploration crews hard at the job in one of the greatest oil searches in modern times.

In the northern bush country, from which I've just returned, shortwave radio and the airplane are oftentimes the sole link between isolated seismo-

CREWMEN *of California Standard Co.'s seismographic camps in Canadian bush country depend on the Beaver for supplies*

graphic camps and their headquarters—300 to 400 miles to the south.

To appreciate the hazardous flying job, you've got to see the country laid out below you. For miles to the horizon, the muskeg stretch is flat as a dance floor. Scattered somewhere in the 400,000 sq. miles of nothingness are a handful of trading posts, still dominated as they have been for 280 years by Hudson's Bay Company. A single graveled-road, the Mackenzie Highway, cuts through 380 miles of muskeg from Peace River north to Hay River, on the Great Slave Lake. From there, through the Northwest Territories and on to the shores of the Arctic Ocean, there are no roads, few landing strips and no directional beams. You fly by instinct, luck and by compass, unless the needle goes whacky—as it sometimes does. Flying is strictly contact, but that's somewhat of a misnomer because there are almost no landmarks either summer or winter.

In winter, the muskegs freeze solidly into a white wilderness where –50° and 30-mph winds are not unusual. In summer, the muskegs deteriorate into a vast floating bog, so tussocked that float planes have a tough time finding enough open water for a landing.

Three years ago, as the twin bonanzas of the Leduc and Redwater fields gushed oil near Edmonton, almost every major oil company rushed crews into northern Alberta. They treked north on the calculated surmise that the underlying pools of black gold which were making western Canada prosperous, extended clear to the Arctic Ocean.

And with the oil explorers came their supply planes. Flying-wise, there was only one trouble: it was almost entirely a winter operation.

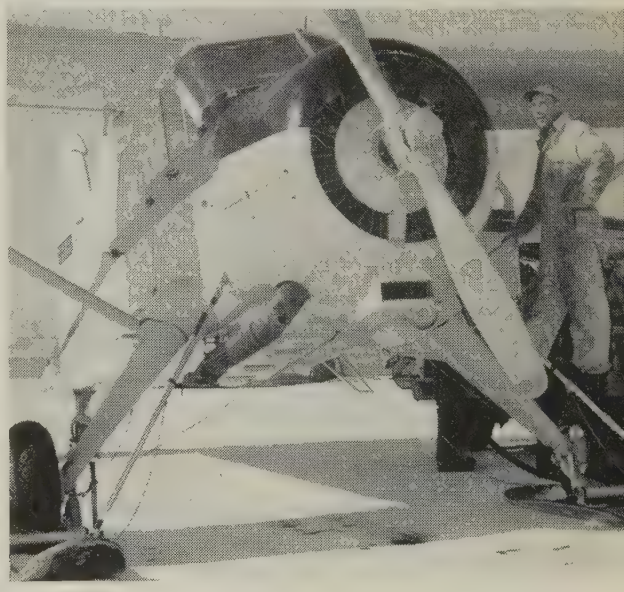
Winter made it even rougher on the pilots. A forced landing in the heat of summer is bad enough, but in winter, with the mercury hovering at –50°, a flyer doesn't stand much of a chance even if he puts his ship down safely. The terrible cold nullifies "safe landings" until they've become something of a joke.

Oil likewise changed the bush pilots' way of life. While muskeg pilots flew wintertimes before the coming of the seismographic crews, they stayed on the ground as much as possible. Now, they fly all winter long, day-in, day-out, supplying the camps. The days when muskeg pilots holed up by a cozy log fire are over.

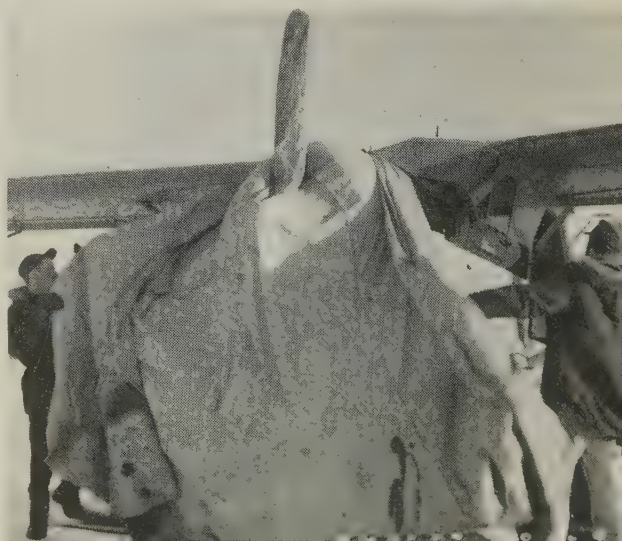
When a muskeg crew moves to a new camp, bulldozers go ahead and gouge a one-way landing strip. Next, planes tote in 55-gallon drums of gasoline, or if anywhere near the (*Continued on page 52*)

HEATED HANGARS *not being a facility on bush country airstrips, Beaver sits out in worst weather. Before take-off, pilot and mechanic rope-off ice and frost*

BEAVER *is an "A&E's dream," according to Alf Taylor (below). Under Taylor's supervision, Beaver gets periodic every 30 hours; complete tear-down at 300*



ENGINE *gets a pre-flight warm-up via flexible tubing which runs from gasoline-engined heater to canvas cover over engine. After warm-up, cover is removed*



FLYING TIGER LINE'S *fleet of 27 C-46's soon will carry a jet Marbore II slung beneath the fuselage, as on this test C-46 (above). This jet unit adds 10% thrust for take-off, and 100% excess thrust at an altitude of 5,000 ft. or more. Marbore II is built in U.S. by Continental*

C-46 plus Jet Pod

by Paul W. Wilder
Chief Engineer
The Flying Tiger Line

A twin-engined airplane is usually twice as dependable as a single-engined craft. The effect of an engine failure isn't so drastic and immediate. But when you operate a twin-engined plane at full gross loads, particularly over high country, the results are still rough and rugged when an engine quits.

Since the cost of new aircraft, particularly four-engined planes, is so high, we at The Flying Tiger Line developed a two-and-a-half-engined C-46 that should come close to solving our twin-engined problems. If our preliminary checks prove accurate, every one of our fleet of 27 C-46's soon will carry a jet engine slung beneath the fuselage.

We hung a 299-pound *Marbore II* jet turbine engine in a nacelle between the main and center spars of a C-46. The unit is 82 inches long and 25 inches in diameter. The housing pod looks much like the tip tank of a present-day jet fighter.

Originally designed by the *Societé Turbomeca* in France, the *Marbore II* is being built in this country by the Continental Motors Corp. The unit develops 880 pounds of thrust and burns 130 gallons per hour at sea level, diminishing to 65 gallons at 18,000 feet. Fuel consumption is actually 1.15 pounds per hour per pound of thrust, and gasoline is taken from the main aircraft system. The jet unit adds 10% thrust for take-off and 100% excess thrust at 5,000 feet or above.

This same system is well suited to modernize any twin-engined executive aircraft on today's market. Douglas DC-3's, Lockheed *Lodestars* and Twin-Beechcrafts would work very well with either this unit or the smaller *Palas,* also a French jet engine, which puts out 342 pounds of thrust. Any well-staffed modification center could handle the research and installation of this type of a unit. Just as a "guestimate," I believe that a DC-3 could be modified similar to our C-46's for about $50,000, assuming that the engine cost half that amount. Once the jet engine is certificated in this country and produced in volume, these costs could be cut appreciably. Also, after an installation

HIGH DRAG *caused by open cylinder of jet pod type is eliminated by a built-in shielding "eyelid." When unit is not in use, "eyelid" (pointed out here) closes*

is once licensed for a certain type of aircraft, subsequent units would be more reasonable since engineering costs would already have been covered.

A unit of this type should be added primarily for increased safety in twin-engined aircraft. Additional cruising speed can be obtained by installing larger regular engines; changing the 1830-92 in a DC-3 to 1830-94 engines, and the 1820-60 in the C-60 Lockheed *Lodestar* to 1820-56.

Using our C-46 for an example, the following conditions can occur. We take-off from sea-level with 48,000 pounds gross weight and climb to cruising altitude. Somewhere between Los Angeles and Salt Lake City let's suppose that we lose an engine while cruising at 15,000 feet. If we use maximum except take-off power (METO), we can indicate 130 mph on one engine and the airplane will be sinking steadily at about 200 feet per minute. Our one good engine will be burning 230 gallons per hour instead of the usual 75 gallons per hour.

With the jet engine, we can feather one of the regular powerplants and maintain 135 mph without advancing the throttle on the good engine. The jet will burn 90 gph or a total of 165 gph, all without straining that remaining "good" engine.

The *Marbore II* is rated at 1,000 hours between overhauls while many jet turbines are still operating at 50, 100 and 200 hours between majors.

For the photos that illustrate this article, Chief Pilot Herbert Wall and I feathered both engines at 15,000 feet with an empty airplane. Our rate of sink was 460 feet per minute with just the power of the jet alone. It was just like flying a great big glider, quiet and almost silky since the noise of the jet was going out the back where we couldn't hear it.

Up to 20,000 feet air-starts have been very simple since we run from 91 or 100 octane fuel. Beyond that height, we are not concerned since our equipment is always so loaded it won't go higher.

We considered several types of installations before deciding on the jet pod approach. Naturally the most efficient aerodynamic approach would be to put the jet engines in the regular engine nacelles with the exhaust pushed out the trailing edge of the wing. The main difficulty of this lies in a potential fire hazard. We lose 2½ mph in cruising speed by putting the engine in a pod slung under the fuselage, but the simplicity of installation more than makes up for the speed loss. We could make the whole unit retract for an extra 30% in weight.

By some simple mathematics, you can see that the gain in engine-out performance with a single jet gives a twin-engined airplane the same safety factor as a four-engined transport. A twin-engined plane with one engine out has only 50% of power available. With the 50% of the one good engine, plus the 100% of excess thrust available at over 5,000 feet, you have 75% of your original twin-engined power output left. That's all you have on a four-engined plane with one propeller feathered.

We plan to install the jets primarily for a safety factor. We'll use them for the first five minutes of every take-off and climb and only for engine failure after that. All take-offs over 45,000 pounds gross will use the jet engines. With the extra power available, we may even be able to put our gross weight above the present 48,000 pounds limit.

To eliminate the high drag that is usually found in an open cylinder of this type, we built a shielding "eyelid." In flight, this "eyelid" is closed to cover the jet's intake scoop and eliminate drag. When the jet is started, the eyelid opens automatically so that the jet can get its breath of air. The doors are wired in series with the engine controls and the jet won't fire until the doors are open.

Since this powerplant became available, we've spent over seven months of research as a joint venture with Continental Aviation and Engineering Corp. We feel that the importance of the development both to airlines and executives planes is in the relatively small cost that will provide jet-type power-boosts for any twin-engined aircraft. The *Marbore II* can be easily adapted to give them prolonged usefulness, thus protecting present investment.

ENGINES *feathered at 15,000 ft. with empty airplane, rate of sink was 460 fpm with just the power of the jet alone*

WEIGHT & BALANCE CONTROL

by Fred E. Hyatt, Jr.

Weight and Balance Control can well be divided into three main stages. First is the weight and balance control exercised by the manufacturer during the design and production stages of the airplane. Second is the weight and balance control exercised by an overhaul or modification plant which converts an existing airplane to meet a customer's special requirements. Third is the weight and balance control of the operating personnel to get maximum performance from their airplanes.

Before going into the different types of weight and balance control, it might be well to define several of the terms used in this article. *Weight*, usually expressed in pounds, is the pull of gravity on an object. *Empty Weight* is the weight of the airplane less all useful load items such as fuel, oil, crew, crew baggage, passengers, passenger baggage, cargo, etc. This term is not of much use to the operator of the aircraft, since it does not represent an actual condition encountered in service.

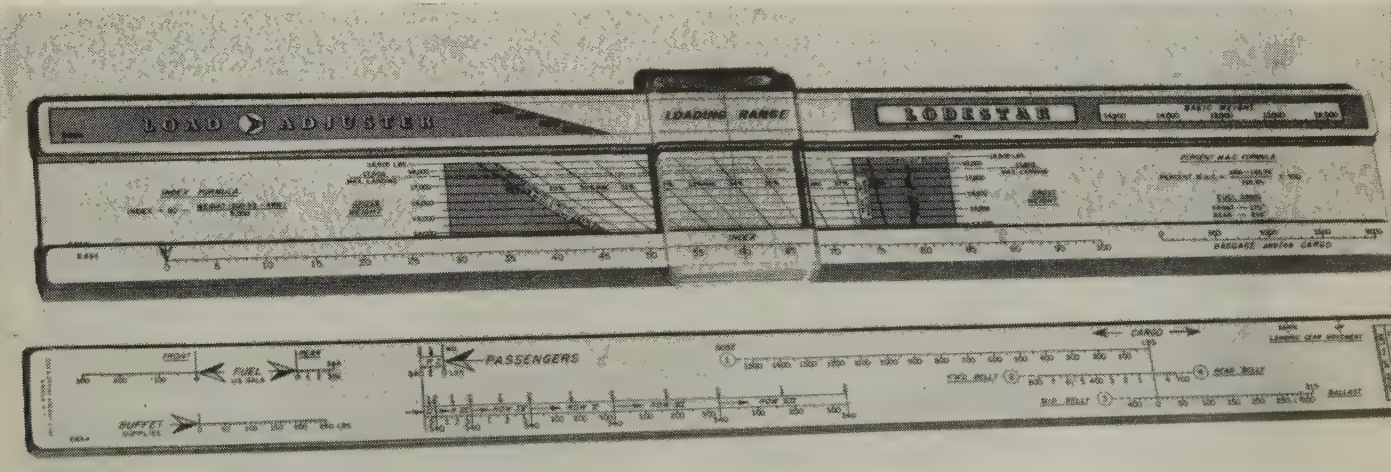
Operating Weight is a term used by the operator in evaluating an airplane. This is the Weight Empty plus engine oil, crew, crew baggage, and any other items which are relatively constant under all loading conditions. To the operating weight we add fuel, passengers, baggage and cargo to obtain the *Gross Weight.*

Center of Gravity is the point about which the airplane would balance if it were suspended in space. This is sometimes stated as a distance from the reference plane and sometimes is expressed in a percentage of the Mean Aerodynamic Chord (MAC). *The Mean Aerodynamic Chord* (MAC) is the average chord of the wing: $\frac{\text{wing area.}}{\text{wing span}}$

Reference Datum, Reference Plane, Reference Point are all used to denote the base point from which the balance calculations are made. The CAA Aircraft Specification for the particular airplane with which you are working will list the location of the basic datum plane and the location of a reference point on the airplane from which measurements can be taken. The relation of this reference point to the datum plane is also given in the CAA Specification so that field measurements can be converted to distances from the datum plane.

The standard method of describing balance on an airplane is to take the example of a child's seesaw. The board has a weight (W_B) with its center of gravity at the center of (*Continued on page 55*)

WEIGHT-BALANCE COMPUTER, *in this case a Cox-Stevens slide rule for Lodestar, is used for quick balance determination*



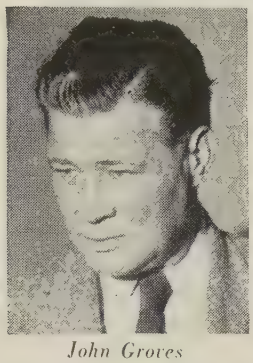
Dr. R. C. Dehmel

Capt. R. N. Buck

Cmdr. W. D. Crockett

Capt. A. L. Ueltschi

Dr. C. P. Seitz



John Groves

DR. R. C. DEHMEL, who developed the well-known Dehmel trainer, joined Curtiss-Wright in 1943; is Chief Engr of Electronics Div. He obtained Ph.D. at Columbia.

CMDR. W. D. CROCKETT, USN, participated in invasion of Saipan, Guam, Pelileu, Leyte, Battle of Leyte Gulf during war; was awarded Air Medal, three Battle Stars.

JOHN GROVES, Manager of Air Transport Association's New York Regional Office, has had a Commercial Pilot Certificate since 1929; was mgr. of Nat'l Airport (D.C.)

LT. COL. DUANE C. TREEMAN, USAF, joined Air Force in 1940; graduated flight training in '41; since then has been mainly associated with bombardment operations.

DAVID G. PETERSON, Chief Pilot of Sinclair Refining Co., began flying by building a glider in 1931. He joined Sinclair in 1944 after service with Boeing and Beech.

DAVID S. LITTLE, Ass't to Director of Flight, joined American Airlines as a Pilot-Radio Engineer in 1939. He was a Commander in the Navy during the war.

CAPT. BEN SCOTT CUSTER, USN, is a graduate of Naval Academy; took his flight training at Pensacola; was awarded Bronze Star, Gold Star, etc., for war achievements.

CAPT. ROBERT N. BUCK has been TWA pilot for 16 years; has flown all their Domestic, International routes. During war, he did weather research for Air Materiel Cmd.

CAPT. A. L. UELTSCHI is head of Pan American Airways' executive transportation department, and is president of Flight Safety, Inc. which was organized in 1951.

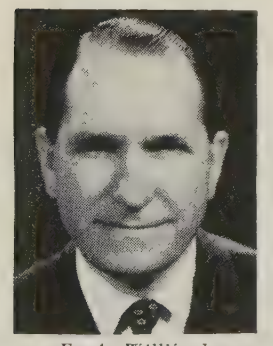
C. P. SEITZ, PH.D. is the Senior Psychologist of the Human Engineering Division of Special Devices Center, ONR. He obtained his Ph.D. degree at Columbia U.

E. ALLEN WILLIFORD joined Link Aviation in 1950 as Vice President and General Manager. He is currently a director of Associated Industries of New York State.

CAPT. LARRY SHAPIRO has been a United Air Lines' Captain for 10 years, and has logged a good 10,000 hours of scheduled airline flying. His home is in California.

DESSEL G. ERICKSON, Assistant Chief, Analysis Div., Bureau of Safety Investigation, CAB, has over 7,000 hours of flying in single- and multi-engine aircraft in all parts of U.S. He joined CAB in '48; was Chief Pilot for RFC in 1945. Mr. Erickson's wife is a private pilot, and all of their six children have been flying since they were 10 days old. He has given over 4,000 hours of dual instruction in all types aircraft.

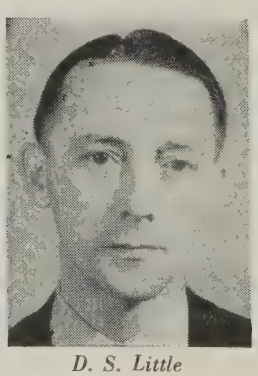
Lt. Col. D. C. Treeman



E. A. Williford

D. G. Peterson

Capt. L. Shapiro



D. S. Little

Capt. B. S. Custer

D. G. Erickson

SKYWAYS

FLIGHT OPERATIONS ROUND TABLE

FEBRUARY, 1953

Wings Club, New York, N. Y.

Crew Coordination and Pre-Flight Preparation

Jerry Lederer (*Director, Flight Safety Foundation*): "I have divided this topic of crews coordination or assignment and pre-flight preparation into five parts:

1. Acceptance of flight.
2. Captain-crew relationship.
3. Types of emergency procedures and training for them.
4. Checking procedure and attitude.
5. Management's responsibility.

"Under the first category, 'Acceptance of flight,' are the following divisions:

a. Flight planning. An example of this might be the copilot doing all the flight planning without being checked by the captain. That was the cause of an airline accident several years ago in which an airliner climbed out of an airport and into a mountain.

b. Pre-flight inspection. This includes the interior of the airplane. I mention this because on a recent flight across the ocean, coming this way, there were no life vests in the seat pockets, none were visible anywhere and the passengers were not given leaflets explaining what to do in the event of ditching until we were just two hours out of Gander, Newfoundland.

c. Checking log books, load manifests, gas slips and clearances.

"In passing, I might mention a few more incidents that would come under this 'Acceptance of flight' category. Last week a pilot told me of an experience he had checking a DC-6 after overhaul. He took off and unintentionally flew into a severe thunderstorm. He was on instruments, but had no airspeed indication and no rate of climb because, in the process of overhauling the plane and repainting it, masking tape had been put on so that it covered the static orifices.

JEROME LEDERER served again as able moderator of the Flight Operations Round Table. He started Flight Safety Foundation in 1948 as a non-profit organization to coordinate and stimulate research, education pertaining to flight safety.

"To further prove the need for pre-flight checking, another pilot reported an incident in which a flight crew, on its way to the terminal in the crew car, saw a DC-3 with a badly damaged control surface preparing to take off. Fortunately, this flight crew was successful in preventing the take-off, thus preventing what might well have been a serious accident. This incident places great emphasis on the need for walk-around inspection procedures.

PRE-ROUND TABLE *get-together found Capt. Buck (left to right), Al Ueltschi, Capt. Custer discussing flight safety with Wm. Person who served as an observer, and Jerry Lederer (back to camera)*

"Under Item Number 2, 'Captain-crew relationship,' I raise the question as to whether or not the crew understands what the captain expects of the individual members in flight, especially under emergency conditions. The idea here is to avoid cockpit confusion.

"Under the third item, 'Types of emergency procedures and training for them,' there are two types of such procedures: one that requires instinctive reaction where there is no time to study manuals, read check lists, etc; and the other where there is time to look over manuals, read check lists or send out for information as to what to do. Typical of an emergency requiring instinctive reaction would be explosive decompression in flight, such as occurred near Denver two years ago with a DC-6. Fire emergencies also would come under the instinctive-reaction category. Emergencies not requiring instinctive reaction would include a stuck under-carriage.

"The fourth item, 'Checking procedures and attitude,' brings up the question, should a crew be checked as a team or should the men be checked individually? The matter of getting the proper attitude among crew members is very important. A captain who has a mature attitude toward his profession will, I believe, invite and accept monitoring of his own actions and insist that crew members monitor each other.

"Concerning attitude, there is the problem of complacency—how can it be combated among flight crews?

"One airline, in trying to teach flight crewmen how to put on smoke masks, was struck by the lack of school-room interest in how to use an oxygen mask. The airline decided to do something about it. At the close of the next meeting, a smoke bomb was set off in the room and all the doors were locked so the boys couldn't get out. Needless to say, the boys' interest in oxygen masks was immediate. Perhaps the airlines will have to resort more to that sort of thing to arouse interest from time to time.

"Also pertaining to this matter of checking procedures and attitudes, I'd like to read off a list of eight different reasons why an air transport (not a U.S. line), flying 40° off course, crashed. This accident took place some months ago. According to a report, the airplane cracked up because 1) faulty use by the navigator of the variation setting control on the gyrosyn compass (he multiplied all his corrections by 10); 2) faulty checking of the compasses by an incorrect astral bearing and without aid of radio bearings; 3) incorrect inference drawn by the captain pronouncing the gyrosyn compass correct and the magnetic compass unserviceable; 4) fault on the part of the captain in not returning to home base when the magnetic compass was regarded as unserviceable; 5) inability of the crew to determine the aircraft's position properly by the standard methods when the gyrosyn setting error was discovered; 6) inability of the crew to realize that the astro shots were being taken on the wrong stars; 7) lack of decisive action on the part of the captain once he knew he had lost his way; and 8) ignorance on the part of those on board of the assistance which could have been afforded by a nearby airfield. This is probably a classic case of what we're here to discuss.

"Typical of the fifth item, 'Management's responsibility,' might be a recent incident in which an airplane was ditched at sea and the crew was unable to get the life rafts to the door because of the very difficult position in which they'd been stored. Another example might be the instance where explosive decompression occurred at 20,000 ft. and the crew immediately put on their oxygen masks, only to discover they couldn't talk with each other because

there were no radio mikes in their masks. I'd say this is where management is making it difficult for the crew to do a job efficiently.

"With that summary, I'd like to start the discussion on acceptance of flight, including flight planning, pre-flight inspection, etc."

Robert N. Buck (*Air Line Pilots Assn., Capt., TWA*): "I'd like to break down the general idea of crew coordination into four categories. First is Policy and Procedure—everyone knowing what his job is, whether of the flight itself or its emergency procedures, and doing it according to the operations manual or its equivalent.

"Second would be Training, so that in one phase of training everyone would know what the policies and emergency procedures are, and in the second phase of training, everyone would be sure that he and all others could do them.

"Third would be Communications, so that once the flight has begun there would be adequate communications. It's pretty simple in a DC-3 to talk over to the copilot or vice versa, but in the large 10-crew aircraft, communications is a great problem and an important one.

"The fourth category would be what I call 'Command.' Perhaps 'leadership' would be a better term, leadership to coordinate all this. There should be someone in command.

"Jerry, while on this 'Command' item, I'd like to reply to your thought of criticism to the commander of the aircraft. I think that if the commander of the airplane is doing a dangerous thing, let's say that his minimum is 300 ft. and he's down to 150 and doesn't see anything yet, it would be the duty of the copilot to call the commander's attention. But I think that any further criticism should be restricted to check personnel or check pilots. The minute each crew member begins to criticize the other, there's a division of authority and a division of ideas that could develop a bad situation. Let's say an emergency occurs and the leader of the flight wants the flight engineer to do a certain thing, but the flight engineer had decided he wants to do something entirely different. If the flight engineer has been in the position of constantly criticizing someone above him, he loses respect for that person's judgment. Along those same lines, the captain of the aircraft or the leader should know the job of each person in the crew so that he does have their respect.

"Going back to 'Policy and Procedures,' if the policies and procedures have been set up correctly, the pre-flight and planning of the flight becomes almost automatic. I know in the case of TWA, the flight engineers do a very good job of inspection of the aircraft. It's automatic with them; it's automatic that the copilot begins on the flight plan after you've consulted. Whether it's correct or not is up to the commander of the airplane. It's his job to check his crewmen."

Jerry Lederer: *"Perhaps 'monitoring' would be a better term to use. When something has gone wrong, should one man have the job of checking it or should anybody try it?"*

Capt. Buck: "I feel it's one man's job. There's someone holding the show together and it's his job to monitor it. Of course, if something has reached the point of being dangerous, then anyone should call attention to it.

"As to whether people are trained collectively or individually, I think it should be individually. It's a natural fact in airline flying that you're going to have different men in the crew all the time. What with flight time limitations being different for different jobs, illness and what-have-you, it's very difficult to keep nine or 10 people together. Each person should be checked to know that he can do his job and do it properly. Then periodically any given crew should be checked to see that the thing is working as a whole."

Larry Shapiro (*Capt., United Air Lines, Air Line Pilots Assn.*): "Jerry, in your introduction you mentioned an accident which in your opinion was caused by poor flight planning on the part of the copilot and which apparently was not checked by the captain. As I recall this specific accident, the take-off was made from (*Continued on page 34*)

TRAINING *should be done individually, according to Capt. Buck (below, left); the crew should be checked periodically. Mr. Person (right) is former American Airlines pilot*

MAIL CIRCUIT BY 'COPTER

New York Airways, Inc. begins air mail operations in New York area

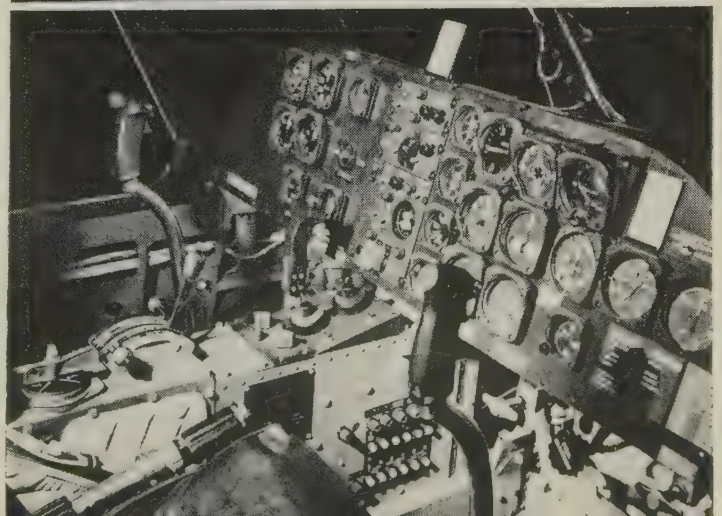
NEW YORK AREA MAP *shows certificated routes, intermediate points, terminals of New York Airways. Heavy solid line connecting Newark, LaGuardia and N.Y. International Airport was first route; by mid-1953, 43 communities will be served*

EQUIPMENT *in Dispatcher's office includes 250-watt Wilcox 305A receivers operating on 131.9 mc, and a Wilcox transmitter. Dispatcher Fucigna (center) is on radio; Pilot Higgins reads teletype; Chief Engr. Gallagher checks charts*

AIR MAIL *and air parcel post is shown here being put aboard one of New York Airways' S-55's. Although now carrying only mail, parcel post, New York Airways has been certificated for carrying freight, express as well as passengers*

New York Airways, Inc. recently began mail operations in the New York Metropolitan area, serving Newark Airport, LaGuardia and N.Y. International, plus eight communities in Westchester and Connecticut. The inauguration of this air mail and air parcel post service is the first step in what eventually will become cargo and passenger helicopter service for the area. By mid-1953 New York Airways plans to be in 'round-the-clock operations covering a radius of 50 miles and serving 43 communities. When N.Y. Airways first started (route shown on map in heavy black line), only one Sikorsky S-55 was used; today three S-55's are in operation, making two flights daily, 7:30 A.M. and 1:45 P.M. Called the "Skybus," the S-55 features emergency flotation gear carried in quick-opening cover to the right of S-55's hatch. Radio equipment carried by "Skybus" includes 35-watt Bendix VHF transmitter and an MN-85D VHF navigational receiver. Chief Pilot is Howard Higgins; Dispatcher is W. Fucigna; Chief Engr. is Jack Gallagher.

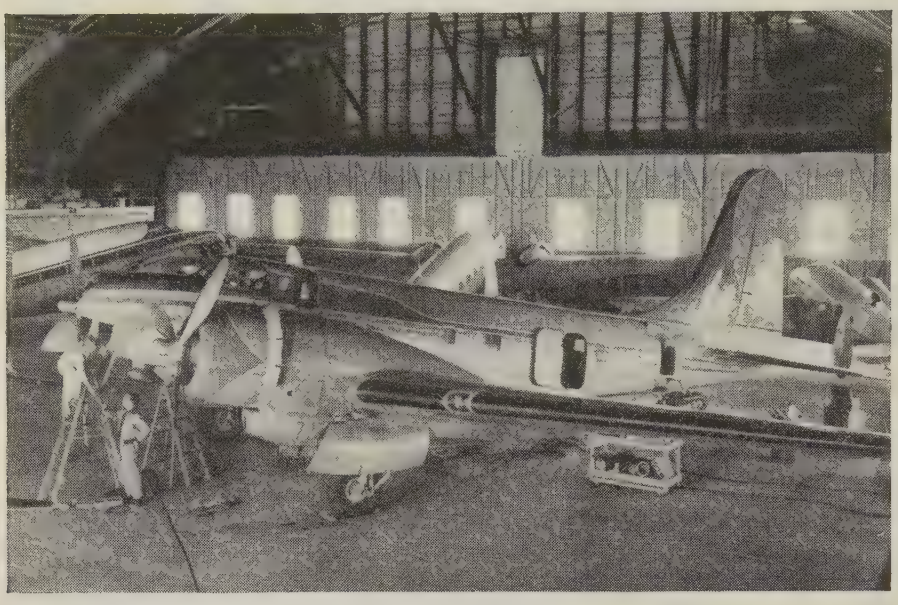
SKYBUS, *taking off from LaGuardia, is on its way to Newark, just 10 minutes by air. The S-55 has a reinforced tail rotor pylon. The 600-watt Grimes landing light, located under rear of fuselage, is to be relocated further front*



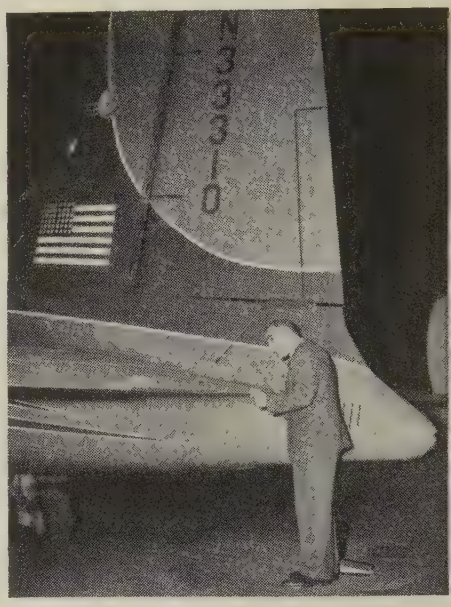
INSTRUMENT PANEL *S-55 features Sperry H-3 electronic gyro horizon, located in upper right of panel; and General Electric G-2 remote indicating compass on H-3's left. Instruments are sealed in helium for better flight stability*

SKYWAYS FOR BUSINESS

NEWS NOTES FOR PILOTS, PLANE OWNERS OPERATING AIRCRAFT IN THE INTEREST OF BUSINESS



GENERAL ELECTRIC *recently added a third B-23 to its executive-plane fleet. Conversion work is currently being done in the Continental Can Company hangar at Morristown, N. J.*



ELEVATOR *movement on the B-23 gets a check by Senior Pilot A. Boyajian*

General Electric Readying Third B-23 for Executive Operations

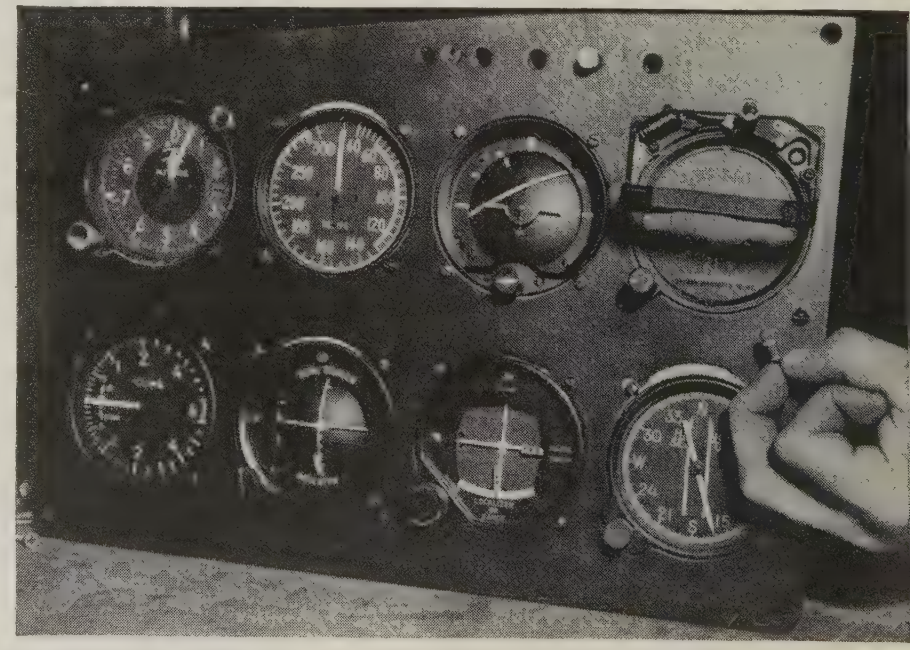
Morristown, N. J. Some three or four months ago, General Electric Company added a third Douglas B-23 to its executive aircraft fleet. This third one, purchased from Fairbanks-Morse Co., is now in the Continental Can Company hangar at Morristown, N. J., for additional conversion work. Among the innovations being worked into the "new" B-23 are the latest Zenith "Wincharger" PV-16AP inverters of 750 V.A. located in the baggage compartment and mounted with the shafts at right angles to the longitudinal axis of the aircraft. It is believed that mounting the inverters this way will assure longer life for the shafts and bearings because the airplane's motion is more up and down than side-to-side rocking. Also, with the inverters isolated in the baggage compartment their noise will not be heard either in the pilot cabin or in the passenger section. These Zenith inverters were installed upon the recommendation of the Sperry Co. because frequency can be adjusted to the very close limits necessary to the good operation of the Sperry H-5 horizon and the Zero Reader, with which the GE B-23 is equipped.

The baggage compartment also contains 200,000 BTU Janitrol combustion heater.

The instrument panel installed in this B-23 and in GE's other B-23's was designed and built in the shop in the CC hangar. The instruments are grouped in such a way that a complete electrical system is on the pilot's side, and a complete vacuum system is on the copilot's side. A new system of instrument illumination, developed by GE and Grimes, has been used. Each instrument has two small GE 327 bulbs mounted above it. Groups of instruments have their lights controlled by a rheostat to vary the illumination, and the position of these lights prevents any flare-back. The GE 327 bulb was designed expressly for this set-up, and the bulbs are now in production for those who want to use them.

The B-23 is powered by two Wright B-2600-23 engines of 1600 hp each, and the plane cruises at 230 mph. With 400-gallon long-range fuel tanks installed in the wings, the plane has a range of 9 or 10 hours and is used in all-weather coast-to-coast service. It

INSTRUMENT PANEL *on the General Electric B-23 is illuminated via a new system developed by GE and Grimes. Each instrument has two small GE 327 bulbs mounted above*



is equipped with omni, dual ADF, VHF and HF, and average flying time for the B-23 is 45 to 50 hours a month.

Chief pilot for the New York Division of GE is Andrew Boyajian; copilot is Edwin G. Fisher, and Max Beitscher is Superintendent of Maintenance. Wayne Perry is GE's CAOA representative.

Corporation-Owned Aircraft Fly More Hours than U.S. Airlines

Washington, D. C. Corporation-owned aircraft flew a total of 2,986,000 hours last year (1951), some 730,000 more hours than were flown by the domestic airlines during that same period, according to the Aircraft Industries Association.

The fast-growing fleet of company planes now totals an estimated 9500 aircraft, of which some 1700 are multi-engined. Thus, the multi-engined corporation fleet is larger than that operated by all U.S. scheduled airlines combined.

CAA Reports Cleveland Tower Busiest; Up 17% Over 1951

Washington, D. C. Airport traffic control towers operated by the CAA handled 16,673,562 landings and take-offs during the last fiscal year, Administrator Charles Horne reported recently. This total is up 2% over 1951. Aircraft operations were highly concentrated: at each of 63 airports there were over 100,000 operations; of these, 26 airports had totals of more than 150,000, and 11 had totals of more than 200,000.

The Cleveland tower remained the busiest, with 327,943 landings and take-offs, an increase of 17% over 1951. Almost three-quarters of Cleveland's activity was civil, non-air carrier flying.

Second place continues to be held by Chicago's Midway Airport, Air carrier traffic largely accounted for its total of 277,411 operations, a net increase of 13%.

Denver jumped to third place, probably because of large increases in non-air carrier and military flying. Its total was 254,239 operations.

Miami holds fourth position with 246,426 landings and take-offs.

New Type Floor Covering Introduced for Airline, Corporate Use

Cleveland, Ohio. A new type of floor covering, called Durug, is being enthusiastically received by both airline operators and operators of business aircraft. Where regular carpeting often has to be replaced every few months, Durug is long-lasting and resists wear and scuffing. The base of Durug carpeting is Fiberglas, well known for its endurance and inability to burn. This material is vinyl coated by the Duracote process, and the result is Durug. This new floor covering, already in extensive use on several airlines, is not stocked in standard colors. The Duracote Corporation can match any color sample submitted. Durug is non-absorbent, does not gather odors, is unaffected by moisture or by oils and greases, and is mildew and rot-proof. For further information and actual samples, write to Duracote Corporation, Ravenna, Ohio.

. . . in the Corporate Hanger

A de Havilland *Dove* belonging to Inter-Office Transportation Company, New York, has been in the shop at Atlantic Aviation for installation of a radio system incorporating dual omni using a Bendix NA-3 and an ARC Type 15C. The installation also includes the Bendix MN-31 ADF, MN-53 marker receiver and an ARC Isolation Amplifier. Transmitters are Bendix TA-18 and ARC T-11. Pilot of the *Dove* is Neville Watson. CAOA representative is Gordon B. Tweedy.

Jack Jones brought his company's PV-1 to Aerodex, Inc., Miami, for repairs to plane's tail wheel assembly, damaged in taxiing at Chicago Airport. While the Fairbanks-Morse PV-1 was undergoing repairs, Jones borrowed one of Aerodex's DC-3's for a quick trip to Boston. F. Page, Aerodex Customer Service representative, went along as copilot.

Northside Chevrolet Company of Indianapolis has its new Twin Beech in operation after installation of a complete custom radio lay-out and a Lear L-2 auto pilot. Northside's pilot is Bernard Sproch.

Dresser Industries *Ventura* brought John Foster Dulles to Dallas recently for a speaking engagement, after which Larry Montigny and his copilot Al Hunter flew Mr. Dulles to Mexico to visit his son, and then back to Dallas and on to New York. Southwest Airmotive turned over the office of its prexy, George Jalonick III, to Mr. Dulles for a press conference.

Meridith Publishing Co. of Des Moines, Iowa, has bought a newly converted Lockheed *Lodestar* from American Aircraft Corporation, Teterboro, N.J. The plane had zero-time engines installed at Gopher Aviation, Rochester, Minn. Chief Pilot and CAOA representative for Meridith is L. L. Richardson.

The Twin Beech belonging to Alexander Smith & Sons Carpet Co. is back in service after completion of 1,000-hour inspection by Atlantic Aviation. Mike Stevenson is pilot.

Ford Gun and Machine Company's DC-3 is flying the skyways again after radio repairs by Aerodex, Inc.

Randy Esperson, pilot for the Dr. Pepper Co. of Chattanooga, Tenn., brought his company's Aero *Commander* to Indianapolis and Roscoe Turner Aeronautical Corp. for installation of ARC radio and the Lear L-2 auto pilot.

Lion Oil Co. of El Dorado, Arkansas, has its second Lockheed *Lodestar* "Executive." The plane is equipped with Pratt & Whitney R1830-94 engines, long-range fuel tanks and latest radio equipment available. A Lear L-2 is part of the equipment, along with indirect red lighting for easier night flying. L.B.S. Aircraft did all the work. Pilot is Gerald Gamill; copilot is Herb Bates.

Maxon, Inc.'s Twin Beech has been in the shop at Southwest Airmotive for repairs and an engine change. J. N. Cornwall is Maxon's pilot; Mario Oddo is Maxon's mechanic.

Ward Bond, Clyde Pangborn and Bill Lear in a *Lodestar* stopped off at Aerodex for minor metal and radio repairs to the airplane.

Russ Lamb, pilot of Cornell-Dubilier Electric Corporation's Twin Beech, has the plane flying again after installation of de-icer boots by Atlantic Aviation.

Bill Worden of Worden Auto Sales has his *Bonanza* back in the air after a complete overhaul by Roscoe Turner Aeronautical.

Charles Weeks, Jr. brought Florida Airmotive's Twin Beech to Aerodex for major landing gear modifications.

New York Wire Cloth Co.'s Twin Beech is back in service after a dual engine change by Atlantic Aviation. Chief Pilot and CAOA representative for New York Wire Cloth is Stan Smith.

CAOA report

CORPORATION AIRCRAFT OWNERS ASSOCIATION, INC.

Corporation Aircraft Owners Association is a non-profit organization designed to promote the aviation interests of the members firms, to protect those interests from discriminating legislation by Federal, State or Municipal agencies, to enable corporation aircraft owners to be represented as a united front in all matters where organized action is necessary to bring about improvements in aircraft equipment and service, and to further the cause of safety and economy of operation. CAOA headquarters are located at 1029 Vermont Ave., N. W. Washington 5, D.C. Phone: National 8-0804.

Air Force and Civil Airports—

High-handed Air Force actions recently taken in reactivating a number of civil airports which were formerly used as military air bases and projected encroachment upon other civil airports purported as "essential" to Air Force expansion, is having a far-reaching and repressive effect in many areas of the nation on general civil aviation. This serious threat to the continued growth and development of corporation flying, in particular, must be strongly challenged before the present list of 35 airports is enlarged to include other important civil airports.

When the Air Force "takes over" a civil airport or locates thereon any type of permanent establishment, it usually results in banning practically all civil aviation activities from the airport. In certain specific cases, general aviation activities (private aircraft owners, flight training schools, fixed base operators, maintenance and repair services) have been physically forced to move from the airport to either an inadequate location in the area or entirely forced out of business.

Magnanimously, the Air Force has stated that "the nation's airpower does not consist merely of its military air force and bases, but also includes as essential elements its civil airports, its aircraft production facilities, its civil aircraft and equipment, and its skilled civilian personnel. . . ."

Although the above statement is supposed to officially represent the policy of the Air Force with respect to civil aviation and the national interest, its arbitrary reactivation of civil airports is certainly inconsistent with those views.

An Airport Use Panel, a joint military-civil organization established for the express purpose of reviewing any cases where specific conflict occurs between military and commercial operations at the 35 key airports involved, recently met with representatives of the scheduled airlines at Miami. So many complaints had been voiced by the airlines against military encroachment and threatened encroachment that a full-dress review and discussion had to be called to resolve serious differences. It is reported that the airlines presented a strong case and faired exceptionally well in the final decisions made by the Airport Use Panel.

Several meetings have been held with members of the Airport Use Committee of the Emergency Aviation Council (of which CAOA is a member) to fully explore the direct impact of the Air Force civil airport action upon general civil aviation and corporation flying. It was finally resolved that a hearing similar to that recently held for the airlines would be requested of the Airport Use Panel. At that time, a "bill of particulars," representing the individual and concerted views of the various national civil aviation associations, would be presented with the intent of smoking out a definite declaration of policy regarding general civil aviation by the Air Force.

More About TV Towers

As mentioned in the July issue of the *CAOA Report*, TV tower construction is a potential threat to flights over existing airways as well as off-airways flights. CAOA has entered a strong protest with both the FCC and CAA regarding the location and lighting of these towers.

In this connection, a recent meeting was called by the FCC-CAA to discuss the problems arising from the projected construction of hundreds of new towers across the nation, ranging anywhere from 200 to 1,000 feet in height. A report was submitted by a working group set up to determine a method of achieving uniform treatment by the Regional Air Space Subcommittee of applications for radio and TV towers over 500 feet in height located off of but adjacent to presently existing airways.

Conclusions reached at the meeting are as follows:

1. The CAA requested that some specific provision be made in FCC Rules, Part 17, to require the lighting of towers during construction. It was agreed that a suitable provision of this type will be included in any proposed rule making of Part 17. This Section should read as follows:

"During construction of an antenna, lighting is required, at least two 100 or 111-watt lamps (#100 A21/TS or #111 A21/TS, respectively) enclosed in aviation red obstruction light globes, shall be installed at the uppermost point of the structure. In addition, as the height of the structure exceeds each level at which permanent obstruction lights will be required, two similar lights shall be installed at each level. These temporary warning lights shall be displayed nightly from sunset to sunrise until the permanent obstruction lights have been installed and placed in operation, and shall be positioned so as to insure unobstructed visibility of at least one of the lights at any angle of approach. In lieu of the above temporary warning lights, the permanent obstruction lighting fixtures may be installed and operated at each required level as each such level is exceeded in height during construction."

2. An inquiry was made (a) as to whether the procedure for handling applications for antenna towers had been changed by the working Group Report, and (b) suggested that Part 17 might be modified with respect to the cleaning and repainting of towers.

It was agreed that the existing procedures for the Air Space Subcommittee handling of antenna towers are adequate and no change was contemplated.

Attention was invited to Section 17. 31 of Part 17, concerning the cleaning and repainting of antenna towers. No difficulty has been experienced in the enforcement of this section, which has been in effect for the past two years, and it was agreed that no further action on this matter is required at this time.

3. Information was requested concerning the 190-mile co-channel separation of television stations and whether or not this criteria is so inflexible that a real problem in air space consideration for television towers might result. Since, in general, the separations in the television allocation are greater than 190 miles, it was agreed that although a few individual cases might present some problems, no further action on this matter was required at this time.

Objection was raised concerning Section IV of the Report which contains the statistical data relating to the percentage of towers over 500 feet to be constructed. Those present did not support this opinion and it was agreed that FCC Commissioner Webster and CAA Deputy Administrator F. B. Lee would accept the Report, for consideration by their respective agencies, with the changes as outlined.

CAOA National Headquarters will continue reporting new developments as they occur.

Altimeter Errors

The errors of the pressure altimeter are, and have been, common knowledge to the air transportation industry for a number of years, and yet sufficient effort has not been made to provide the pilot with an altimeter that is not subject to false indications.

The magnitude of these errors, when added, could have been the contributing cause of a number of aircraft collisions with mountainous and hilly terrain.

To briefly review altimeter errors, four (which are generally mentioned in text books and industry publications) are:

1. Horizontal pressure gradient error, which is caused by difference in pressure in the same or different air masses.
2. Air temperature error, caused by the calibration of the altimeter at a standard temperature of 59° F. at sea level.
3. Local mountain effect.
4. Instrumental error, such as lag error caused by mechanical linkage, etc.

Two major errors seldom compensated for are the ones caused by temperature and local mountain effect.

The temperature error is easily determined on any navigation computer, yet it could be of such sizeable amount that it could cause traffic conflictions of serious consequences if one pilot compensated for the temperature error and others did not. The errors shown below are not exact, but include any plus or minus interpolation error when the readings are taken from any standard navigation computer. A temperature of 20° C. below standard is used for all altitudes listed.

Indicated Alt.	*Actual Alt.*	*Error*
3,000	2,800	200
5,000	4,640	360
10,000	9,250	750

The local mountain effect is caused by the acceleration in a mass of air as it is squeezed through a pass or over a ridge. The pilot has no means to determine the magnitude of this localized low-pressure error which, again, could be sizeable.

Pending receipt of the results of the actual tests conducted by the NACA on altimeter error caused by orographic lifting, the following chart shows the calculated error in feet with the corresponding wind differentials:

Velocity of Wind Over Ridge

	MPH	*25*	*50*	*75*	*100*	*125*	*150*
	25		63	168	313	505	736
Velocity of	50	E		106	250	437	670
Wind over	75	R			143	331	565
Flat Terrain	100	R				187	420
	125	O					228
		R					

Example: If a pilot maintained his indicated altitude in an air mass that was accelerated from 25 mph over flat terrain to 150 mph over a ridge or through a pass, his actual altitude would be 736 feet lower than the altimeter indicated.

Now that pressurized aircraft are descending 1,000 to 2,000 feet per minute, altimeter lag error may amount to 200 feet or more.

When all the errors of the pressure altimeter are added, their magnitude is so great that altimeter errors cannot be discounted as the probable cause of a number of aircraft collisions with the terrain.

It is hoped that the above altimeter error information may be helpful as a reminder of piloting technique we sometimes forget or overlook.

Canadian Trans-Border Regulations

The Civil Aeronautics Board is concerned over the fact that aircraft operators of United States nationality are not complying fully with Canadian regulations in filing applications with the Canadian Air Transport Board for permits to conduct other-than-scheduled trans-border air services pursuant to the arrangements made last March by an exchange of letters between the CAB and the Air Transport Board.

The services which may be authorized under these arrangements are described by the CAB as common carrier operations of a casual, occasional or infrequent nature between certain areas of Alaska and Canada, with large or small aircraft. The arrangements do not affect cross-border operations of personal civil aircraft.

Realizing that the failure to comply with the regulations of the Canadian Air Transport Board may be the result of misunderstanding, it was explained that the following procedure should be observed: The original and two copies of each application by a U.S. operator should be submitted to the Air Transport Board, Ottawa, Canada; three additional copies should be furnished to the Foreign Air Division, Civil Aeronautics Board, Washington 25, D.C. The CAB will then transmit two of the latter copies to the Department of State for submission through diplomatic channels to the Canadian Government.

The CAB stated that if the new arrangements are to work satisfactorily, all U.S. operators must comply with the requirements of the Canadian Air Transport Board in the filing of applications.

Your Executive Director has discussed with the CAA ways and means of improving corporate aircraft movement to Mexico, the Caribbean area, and South America.

From time to time, reports have been received by the CAA that difficulties have been encountered by executive aircraft in egress and ingress into the above countries and dissatisfaction has been expressed regarding handling methods of the U.S. Customs and Immigration officials. In order to reduce the red tape and simplify entering and leaving foreign countries, we would appreciate your advising us of any specific delays you have experienced, including factual data regarding each case. This information will be submitted to the CAA and the Treasury Department for review and necessary action to assure fewer complications.

Aircraft Flare Renovation

Kilgore, Inc., Westerville, Ohio, brought CAOA's attention to the fact that at least 50% of multi-engine aircraft used in corporation flying are equipped with flares, but only a small number have done anything regarding renovation of these flares for proper use.

Since the flares in your plane may be the means of saving it at night under unforeseen adverse conditions caused by weather, equipment failure, exhausted fuel supply or a combination of circumstances beyond your control, it is only logical that these flares should be in a positive functioning condition.

Experience during World War II indicated that under certain atmospheric conditions, the functioning and efficiency of these units, which have been in service over an extended period of time, may be affected. This is particularly true of the illuminant itself and with certain metal parts wherein corrosion may take place. Rough handling of these units also enhance the possibility of moisture entering through broken seals.

In order that you may have complete confidence in your flares at all times, they should be returned to the manufacturer at intervals of *two years* for a complete overhaul and inspection.

If your flares have been previously inspected, they will have the date of inspection printed upon them.

The CAA has issued Aviation Safety Release No. 321 covering "*Information Regarding The Dropping of Parachute Landing Flares from Aircraft, Their Inspection and Renovation.*" If you do not have a copy, by all means request one from—Civil Aeronautics Administration, Office of Aviation Information, Room 1717, T-4 Building, 16th and Constitution Ave., N.W., Washington 25, D. C.

Kilgore, Inc., has assured CAOA that they gladly will answer any direct inquiries regarding renovation, inspection, or overhaul of flares.

NEW MEMBERS OF CAOA

1. Bowers Battery & Spark Plug Co., Reading, Pa.
2. Fram Corporation, Providence, Rhode Island
3. Inter-Office Transportation Co., Inc., New York, New York
4. Paul Mellon, Pittsburgh, Pa.
5. Owens Illinois Glass Company, Toledo, Ohio
6. Mine Safety Appliances Company, Pittsburgh, Pa.
7. Skymotive, Incorporated, Park Ridge, Illinois
8. The Remmert-Werner, Inc., St. Louis, Missouri
9. Bendix Aviation Corporation, Detroit, Michigan
10. Lockport Felt Company, Newfane, New York
11. North American Aviation, Inc., Los Angeles, California
12. Lockheed Aircraft Service, Inc., Burbank, California
13. Byron Jackson Co., Vernon, California

KIMBERLY-CLARK CORP., *well-known manufacturers of paper products and members of CAOA, operates this DC-3 for business purposes. The plane, formerly owned by United Air Lines, is based at Oshkosh, Wis. A. T. Groves is pilot, and Jim Champion is copilot. Kimberly-Clark also operates a Twin Beech, and its Canadian subsidiary company has a DC-3*

Performance

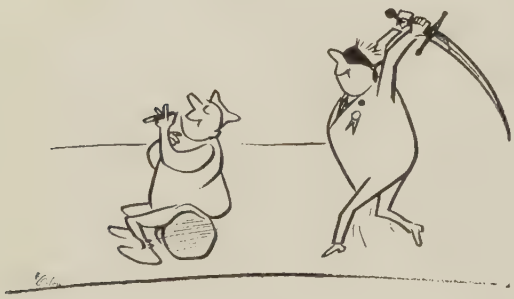
from the Files of the Flight Safety Foundation

Safety Wire

Safety wire has uses other than for locking nuts or studs. In many locations on aircraft, safety wire is used to keep a lever or handle from vibrating or falling out of place, or to show (when the wire is broken) that the device has been used. At these points safety wire of low strength is specified so that it can be easily broken by hand power when it is necessary to use the wired item (as on some fire extinguishers).

A recent letter from a pilot relates that his hydraulic pressure failed, requiring use of the air bottles for braking. When he pulled the air bottle control, he found the safety wire too much for his strength. The mechanic, in rewiring the handles, had used a heavier gauge wire than was called for.

Watch out for this. A periodic check should be made of the type of safety wire being used.



Executive Accident

During a stop-off on a Gubernatorial election campaign trip, a small executive plane was cleared to taxi through the loading area of the airport. At the time there were three Air Force twin-engine transports parked in front of the Administration Building. The transports, separated by approximately 60 or 80 ft., were being loaded with emergency supplies for a flood area. Four service personnel had gone to the center of the loading area for a smoke. They were sitting down with their backs toward the west, the direction from which a small executive plane was taxiing. The pilot of the exec plane failed to see the men sitting there and the men in turn were not warned of the aircraft's approach. Engines of a military transport were being warmed up at the time and all sound of the taxiing executive ship was drowned out. One of the men was struck and fatally injured by the propeller of the taxiing plane. *Moral:* When taxiing, be sure you have cleared the area ahead of you, and then *double-check.* Expect human beings to appear in any spot that is close to a loading area or scene of ground activity.

ILS Approach

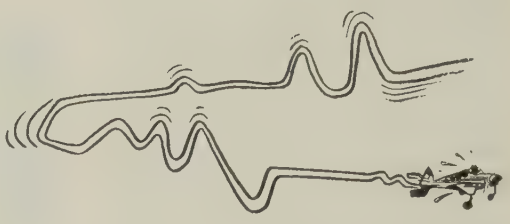
The following acts are judged by check pilots as frequent errors occurring on flight checks:

1. Making large corrections in heading immediately after procedure turn.
2. Controlling altitude poorly at markers; staying above or below glide path.

PITFALLS

by Jerome Lederer and Robert Osborn

3. Over-controlling, causing tail swing.
4. Going below minimum altitude.
5. Chasing needles: flying pointers instead of using other instruments.
6. Not getting settled on localizer by the time the glide path is intercepted.
7. Reversing sensing (localizer indication), confusing color segments (on ILS instrument)



Stop Studs from Breaking

How often have you heard of a broken cylinder hold down stud? A crankcase thru-bolt? A connecting rod bolt? All such failures are closely related and add up to be one of the most frequent types of structural failure experienced with aircraft engines today. Getting rid of this type completely would be quite a task, but the number involved can be reduced greatly by applying a few do's and don'ts.

Cylinder hold-down studs, crankcase thru-bolts, and connecting rod bolts are a few examples of critically stressed parts subject to alternating loads. The manufacturer always gives them a specific nut torque range which must be maintained to prevent failure. The minimum torque value is necessary to avoid fatigue failure and the maximum to avoid exceeding the tensile strength of the stud. The vast majority of these failures experienced during engine operation result from fatigue. The nut is too loose, not too tight. When a nut is tightened too much, it probably winds up in the mechanic's wrench.

Here are some recommendations to follow in service:

1. Apply proper torqe properly. Use a torque wrench. Apply torque uniformly. Know the torque limits. Use the specified thread lube. Examine the mating surfaces—they should be clean, smooth and square. Never sacrifice correct torque for cotter key hole alignment.
2. Be leery of any clip or bracket under a highly stressed nut. It must mate squarely. The hole must be small enough to allow complete contact of the nut face.
3. Remove any aluminum alloy bracket found under a highly stressed nut. Do it immediately.
4. Recheck the torque on nuts holding brackets after a few hours of engine operation. Repeat if looseness is noted.

The man with the wrench is Mr. Important here. If there must be a highly stressed nut, don't let it be the mechanic. +++

SKYWAYS FLIGHT OPERATIONS ROUND TABLE

Skyways Round Table

(*Continued from page 25*)

an alternate airport 24 miles from the scheduled airport. The same heading was apparently used outbound from the alternate field as was normally used from the regular field. This was at night and resulted in impact with an 8,000-ft. mountain. I don't believe it is proper to say that the one and only cause was poor flight planning. I believe that many questions arise as to whether or not the crew had the proper tools to do its job. It is an ironical fact that in most of our million-dollar aircraft today, a flashlight is standard equipment in the cockpit to properly illuminate certain instruments and to read maps and manuals. The problem of immediate visual reference to any critical data regarding the navigation of the airplane has become a real one.

"A pilot's job is one requiring vast knowledge—not only of equipment and emergency procedures but of airports, routes, minimum altitudes and terrain. For example, some airline pilots are qualified from Los Angeles to Seattle and from Los Angeles to New York. It's almost humanly impossible to retain all the necessary information of these routes. It becomes necessary to rely upon data in the manuals. Now, assuming the manuals give us the proper information, the problem that arises is whether or not this information is readily available at the time it is needed.

"As you know, ALPA is interested in the development of a means whereby navigation information is available in the cockpit for continuous visual reference, day and night. United Air Lines has just completed the first phase of evaluating a development along this line. ALPA feels that we must continually strive to improve the tools with which the crew has to work so that the crew work capacity remains well above any possible peak work-load that may be experienced."

Jerry Lederer: "*Capt. Ueltschi, would you have any comments?*"

Capt. Ueltschi *(Pres., Flight Safety, Inc.):* "I happen to be working in the field of corporation pilots, and there's no such thing as route qualifications for a corporation pilot. He flies his airplane where the boss wants him to go. Therefore, he must be prepared to fly anywhere at almost anytime. To be able to do that job safely, depends on crew coordination, the pilot and copilot working as a team so that all effort is in one direction.

"I think an air-tight system of checks and double-checks between the captain and the copilot is an ideal one. A great deal of this can be accomplished by training. I go along with Capt. Buck's idea of training your pilots individually, but with particular emphasis on team work. A musician, for instance, who plays with a symphony goes home and practices by himself, but he also has to practice with the whole orchestra so that they play well together.

"I don't think a pilot should think of himself as being checked. Executive flying or airline flying is a profession and we should consider those fellows as professional pilots . . . and the way a man gets better in his profession is by continuous training rather than by checks or examinations."

Jerry Lederer: "*What you say is undoubtedly correct, Capt. Ueltschi, but I have mentioned several incidents where the necessary work was not done.*"

Capt. Ueltschi: "Well, to go back to flying in a thunderstorm and the pilot not knowing

"**SYSTEM** *of checks between captain and copilot is ideal," according to Capt. Ueltschi*

he didn't have airspeed until after he flew into it, I can't imagine what he was doing on the climb. How did he get to V_1? He shouldn't take off until he passes from V_1 to V_2."

Jerry Lederer: "*The point I wanted to make is that piloting undoubtedly is a profession, but there are enough incidents to indicate it needs more emphasis on attitudes.*"

Dessel G. Erickson *(Acting Asst. Chief, Analysis Div. BSI, CAB):* "Airline pilots are fortunate in that they have people on the ground to assist them in various stages of their flight. They have people who can work loads, who can work on flight plans, etc. The corporation pilot or the private and commercial pilot has to figure out his flight plan, loading, clearance, etc., all by himself. He has to do it before he takes off because he's generally in no position to figure it out after he gets in the air.

"As far as the crew is concerned, a minimum of two competent pilots is required because in airline or executive flying no one knows what emergency can occur: a bird might come through the windshield and injure one of the crew members, or a crew member may become sick from food he has eaten. From necessity you need individually well-qualified crew members and a team that can operate together under any circumstances. Once the non-airline airplane is in flight, assistance is generally not available. In some cases, CAA can supply certain information if it's requested. Normally, however, no one is checking on the flight unless it's on IFR and a flight plan, and then things generally get pretty bad before the pilot wants to acknowledge that he's in trouble, and call for help. In the case of an airline, if it doesn't report at the right time, somebody starts looking for it. But that doesn't apply to smaller craft.

"On this business of pilots not being familiar with areas they fly into, routes, airports or whatever it might be, crew coordination and coordination with CAA and ATC involves the problem of reporting over points which are not marked or well-known to the itinerate pilot. It's quite a problem to go into a strange area. Tower or Approach Control says, 'Report passing such-and-such place.' The pilot doesn't know that place so he doesn't report. Too many pilots don't want to come back and say, 'Sorry, we don't know where that is.' They continue on and do the best they can."

Jerry Lederer: "*What you're saying, Mr. Erickson, leads to the collision hazard. Have you any comments, Mr. Peterson?*"

David G. Peterson *(Chief Pilot, Sinclair Refining Co.):* "In executive flying, this idea of monitoring and checking each other is important because we're flying smaller aircraft and each man doesn't have a single set of duties, like the flight engineer on a *Constellation.* We know a Twin-Beech, a de Havilland *Dove* and even a DC-3 can be flown by one person. I believe checking each other is important because the corporate pilot goes anyplace in the country. An airline pilot is concerned because he has to be familiar with Los Angeles to Seattle and Los Angeles to New York, but the corporate pilot may make a low approach to a field he has never seen before. Therefore, it's necessary for him to get all information out of the book. That means he has to have the manual at hand and his copilot has to do some checking on him. The corporate pilot must realize that he can make mistakes while he's trying to read the manual and at the same time handle the airplane.

"We at Sinclair have made the job a little bit easier. Our company has given us a Sperry A-12 autopilot with Approach Coupler for each plane, even down to the Twin Beech, which makes it easier for one man to do the job and the other to check it. It calls for two qualified pilots to do this job of going into a strange field under tough instrument conditions and traffic.

"On the matter of flight checks, I believe it's important to do the flight checking on routine flights rather than on specific check flights. When you fly a flight check with a pilot, you still don't learn what you should. I think we learn a lot more about a pilot on a cross-country trip. You see how he plans the flight all the way, from the time he gets the schedule.

"As far as reporting visual objects, I think all corporate pilots should say on first radio contact approaching an area, that they're not familiar with local landmarks like the five stacks, Whitestone Bridge, etc.

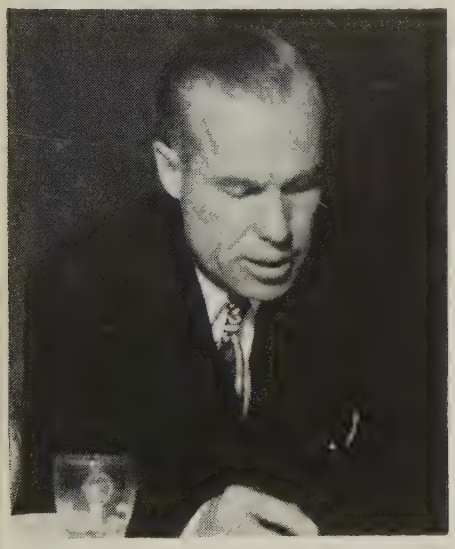
"Also along that line, perhaps we could

work toward a more simple coding of fixes. Marginal communications, or poor communications because someone else is calling on the same frequency, the accent of the operator—all make it difficult to read the proper pronunciation, let alone spell the fixes and read back. If we could have simpler single-syllable identifications instead of the several-syllable identifications or some other coding, it would help a lot. For example, use Otto instead of Albuquerque."

Jerry Lederer: *"Capt. Custer?"*

Capt. Ben Scott Custer, USN *(Commanding Officer, NAS, Floyd Bennett Field):* "I'd like to contribute something on this business of procedure and policy. Of course, the Navy is a bureaucracy and we have what is known as discipline, but our crews have been trained as crews, generally in the big boats and multi-engine planes. When you get a crew in a small ship, they become very intimate and familiar. Despite the discipline handicap that might get in the way of an engineer or one of the crew members speaking up, I think the Navy people would speak up and criticize the commander of the plane or the copilot if something were wrong and they felt there was danger. And yet, because of indoctrination, I don't think we have a tendency to break down air discipline.

"On this proposition of teaching, I think we should get away from the curse of a



"FLIGHT CHECKS *should be done on routine flights," maintains Sinclair's D. Peterson*

check flight. I've been a chief flight instructor at Pensacola and a great many airline and civilian flyers have gone through Navy or Air Force flight training. They probably were afflicted by check-itis. I think it would be very beneficial to have a flight to *assist* them, not check them; have a more experienced pilot go out on a run to see if he can find a way to help the pilot or copilot.

"Perhaps the airlines could develop a system like the Navy's Granpaw Pettibone flight safety column. We found that nothing had been written except case histories of crashes. We decided that if we could get pilots to write of their experiences that had been near-disasters, if we could find out what they had done and how they avoided these crashes, we might get information that would lead us to design changes or a change in a type of flying before a crash developed. The response to this invitation to send in anonymous letters was quite gratifying. We attempted to answer any questions the letters asked, whether it was engineering, flight or operational, and we kept those letters as confidential correspondence.

The primary success of that system is that Grandpaw Pettibone is the only informal character in the Navy. Everybody else is cursed with officialdom and officialese and gobbledegook. But old Granpaw could talk like a homespun philosopher. He even uses a few cuss words, and anybody can write him without going through the chain of command.

"I realize in industry we have bureaucracy, too, and I realize that some of the junior people have to run a gauntlet to get up to the head man. If you had some help for your chief pilots and could handle these things informally, I believe you could learn a great deal."

John Groves *(Eastern Reg. Ops. Mgr., ATA):* "Based upon facts, it would seem to me there isn't any simple answer to the problem we have in high-density terminal areas. We've seen things change in the past couple of years. There's no such thing as having a procedure you can be sure you'll use. For example, let's say you're to fly to Chicago by way of Green 3. You get out to the end of the runway and the Tower tells you there'll be about a 40-minute delay but that they can get you out immediately if you go out to New Rochelle, Paterson and up that way. The pilot agrees to that rather than have the 40-minute wait for Green 3. But then, after getting off the field, somebody in the Tower hollers, 'Make a right turn over the Flushing Meadows.' About the time you get out there, somebody else yells, 'Make a turn and get over Holmes at 2500 ft.' Well, that's a physical impossibility. So it seems to me the question we're facing in high-density terminal areas is how to be able to take our procedures and practices and intelligently use them. It isn't a question of team work so much as it's a question of each pilot knowing what the problem is and being able to translate it into action."

Capt. Shapiro: "Certainly the pilot should know these procedures and should practice them. But the airline pilot's problem is this: he flies from the West Coast to Chicago, but he doesn't get into Chicago more than three times a month. If he flies that run the entire year, he probably will work two or three low instrument approaches and maybe two or three low instrument departures at Chicago. It's therefore extremely difficult for him to be accurately familiar with the procedures. And that gets back to the point I made earlier—do the pilots have the necessary tools in regard to such a problem?"

Capt. Ueltschi: "We recommend to pilots going through our organization to always file an instrument flight plan if they're going into strange areas, and to always report at a radio fix. Even if it were clear weather, if a pilot flies the strange area as he would on instruments, it would be a lot simpler.

UNITED's *Capt. Shapiro questioned whether pilots have necessary tools for their job*

Even if I didn't file a flight plan, I'd give my report to the Tower or Approach Control over the compulsory check points or radio fixes which are clearly marked on the charts."

Capt. Buck: "Going back to Capt. Shapiro's remarks and Capt. Ueltschi's orchestra, you have to have a place to put the music. I think that's what we're talking about when we talk about having the tools to work with. You may have a lap full of Jeppeson or other procedure charts, but they fall down, get wet; it's dark and the light is bad . . . and then at the end of the runway, the Tower says 'Don't go Green 3, go Purple 29 and turn at Podunk.' Sure, you have the information available, but can you get to it or is it in a *readily* available position? The CAR requires directional gyros and many other things, but as yet they don't require a music stand for the music!"

Capt. Ueltschi: "The thing of it is, Bob, we're trying now to use the available information that we have. Say you're going on instruments; you can't see the ground. We go into these different areas and the only thing we have is the book, even though we don't have the stand to put the 'music' on. So we hold it in our laps and do the best we can."

Capt. Buck: "At TWA we always file instrument flight plans, that is, within reason. It's been our procedure for years.

John Groves: "Yes, but what happens sometimes is this: a fellow says, 'If you take it out right away, you're clear.' About that time Junior sitting next to you has the book

(Continued on page 36)

Skyways Round Table

(*Continued from page 35*)

and is figuring out what the routing is when he should be looking out for other airplanes. That's the thing that's disturbing."

Capt. Buck: "Maybe we need an instrument, an optical thing where you push a button and it shows you, well lighted, the various routings."

Capt. Ueltschi: "We're talking about professional pilots now and if a man doesn't know where he's going, he shouldn't go until he does. If the Tower gives him a different clearance than he's filed and if he doesn't know which way he's going, he should just let the airplane sit on the ground. After all, he's a professional pilot and has no right to jeopardize his and other people's safety. We have radar and a few other things to check on him, and if he reports over Great Neck and he's really over Glen Cove, somebody will call him and ask what he's doing over there."

Capt. Buck: "But, as Johnny Groves pointed out, the man is under pressure. If he can't get out right away, he's going to have to wait until . . . tomorrow afternoon."

Capt. Ueltschi: "That's part of being a professional pilot. He must be able to resist the pressure; that's part of his training."

Jerry Lederer: "*We've been talking largely about tools, and I think we should get into the mental angle, attitudes.*"

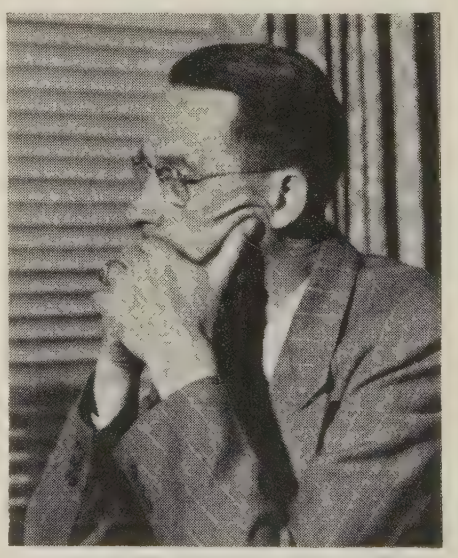
Lt. Col. D. C. Treeman *(DC/S Operations, USAF):* "Prior to my present assignment to Headquarters, United States Air Force, I was a Squadron Commander in the Strategic Air Command. My experience as a Squadron Commander, working directly with combat crews, has convinced me that effective crew coordination can be achieved only by repetitive practice of established procedures; further, that this coordination is extremely difficult to achieve and easy to lose. In the Strategic Air Command, the combat crew member is constantly impressed with the need for effective crew coordination and, by regulation, is drilled continually in those areas where crew coordination is essential. For example, prior to all flights each crew member must repeat verbally to his Aircraft Commander the bail-out, ditching, and crash-landing procedures that he must follow in the event emergencies develop which require their use. In addition, the crew is periodically exercised in simulated bail-out exercises to insure effective coordination of all members. Another example of the continuing emphasis on crew coordination is a regulation which requires Strategic Air Command pilots to make Ground Controlled Approaches on all visual landings. In this, the crew is continually exercised in the technique of instrument approaches and is consequently better able to effect smooth and safe landings in marginal weather conditions.

"Pre-flight preparation has the Aircraft Commander the direct representative of his Squadron Commander. The Aircraft Commander is responsible for making sure his aircraft can effectively accomplish the mission assigned. To assist the Aircraft Commander in this responsibility, each crew member carefully pre-flights the systems for which he is responsible. For example, the radar operator checks the radar system, the bombardier checks the bombing system, the radio operator checks the communcations systems. Finally, the Aircraft Commander receives reports from each crew member and thus is able to evaluate the status of his aircraft. To assist crew members to effectively preflight their equipment, Strategic Air Command has issued manuals which outline preflight procedures for each system in aircraft operated by that command."

David S. Little *(Asst. Dir. of Flight, American Airlines):* "The only comment I'd like to make, Jerry, is on this mental factor you just mentioned. Too often in the past, the legally or company-required efficiency checks have been placed on a strictly check basis, and this does develop cases of check-itis in many people. We finally recognized that fact and about two years ago began stressing the training rather than the check aspects of required flights.

"Through many hours of conference with CAB and CAA over the elements of six-months efficiency checks and through excellent cooperation by both organizations, the current regulations and various documents pertaining thereto are now so worded that any required flights can be on the basis of a training flight.

"Putting all that in example form, the regulations obviously require a certain minimum of flight procedures executed within certain limits. Instead of coldly instructing



"**TRAINING** *should be emphasized rather than the checking aspects," reported Dave Little*

the pilot to proceed with that procedure and then grading him on the proficiency with which he does it, it is much easier to say, 'Bud, let's see how well you can do this.' If he does it within allowed limits, okay. But, let him know beforehand that it's not a one-check-and-you're-out deal. If he wishes to do it over again to improve his proficiency, let him go to it. And if he at first exceeds the allowable tolerances, then proceed to train him in that specific maneuver until you are both satisfied that he's well within the limits, and then establish the legally required grading.

"It has taken a lot of administrative effort to develop that thinking down through our flight supervisors, but I believe the effort has repaid us many times over through improved mental reaction, morale and improved personnel. Most pilots now look forward to their six-months checks on the basis of having an opportunity to do things which cannot normally be done in scheduled operations . . . and do them as long as they wish to do them to attain a certain proficiency."

Jerry Lederer: "*What do you do about the pilot whose ideas are different from those in the manual?*"

David S. Little: "We give him every reasonable opportunity to conform to the desired and then if he will not conform, we remove him from the payroll.

"In American Airlines and I'm sure in all other airlines, a conscientious effort is made to develop the one best procedure for each required action—not just a procedure which one individual or some small group of individuals may believe to be the best. We currently require two six-months instrument checks per pilot per year. We also give each pilot and each engineer two line-checks per year. During this checking, our supervisory pilots endeavor to obtain all pilot reactions, constructive criticism and comments on proposed procedures. These procedures may then be tried out in a limited fashion, but sooner or later they're dumped into one hopper. Once a year we bring all our chief and assistant chief pilots together for a period of a week. We throw out all other business, and just supply these boys airplanes and let them wring out all flight-procedure proposals. Out of this comes an agreed-upon procedure. Of course, not everyone in the airline will completely agree with every procedure, but through the wringing-out process the established procedures are generally agreed to be the best that can be made available at the time. Once such a procedure is frozen, we do try to require complete conformance with that procedure."

Capt. Shapiro: "We must recognize that we've been talking mainly about the skill proficiency of the pilot—his ability to perform certain maneuvers, instrument approaches, etc., but we haven't discussed whether or not this skilled proficiency is a constant thing. The skill proficiency of all the pilots who've had accidents met the requirements of their companies and the CAA. Does this skill proficiency and other efficiencies such as judgment and memory, remain constant throughout the flight?

"What happens to the pilot during the

(*Continued on page 38*)

PLANE FAX

Quick picture of

EUREKA COUNTY AIRPORT

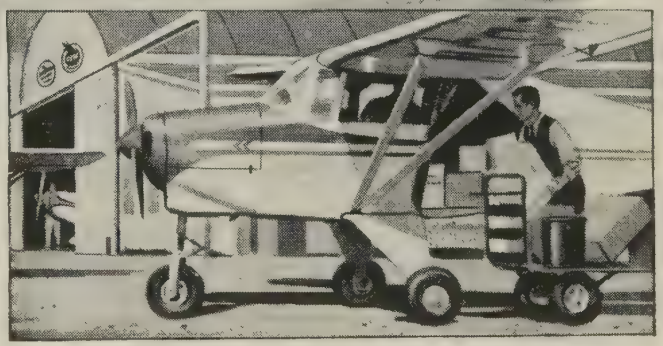
Eureka, California

1800' surfaced runway, lighted at night . . . 2000' sod runway . . . hangar and tie-down facilities . . . complete repair and overhaul for light engines . . . flying school . . . 2 miles from downtown Eureka . . . complete Standard Oil Aviation Service.

A FIRE WATCH FLYER SAYS:

You can get longer engine life

Paul E. Fleming, of Fleming's Flying Service at Eureka, flies regularly for the U. S. Forest Service. Here's what he says about making your engine serve better for more flying hours:



"We do a lot of mountain flying with heavy loads and small field take-offs—tough conditions for any engine. However, our planes often go from 1100 to 1400 hours before major overhaul. We believe the reason is simple—we use RPM Aviation Oil exclusively in our light plane engines, and the record on the 50-odd planes based here shows that 'RPM' definitely keeps rings free, holds valve wear down and keeps our engines clean.

"Take-off power is a must in mountain flying—and we find that we really get it with Chevron 80/87 Aviation Gasoline. Important safety factors, too, are the way Chevron 80/87 ends take-off knocking and pre-ignition. We don't get rough running—and Chevron 80/87 definitely keeps our engines cleaner than other aviation fuels. That's why we recommend Chevron 80/87 and RPM Aviation Oil as your two best buys for better all-round performance and longer engine life."

T.M.'S "RPM", "CHEVRON," REG. U.S. PAT. OFF.

TIP OF THE MONTH

Paul Fleming says: "When you have to land in a small field it's safer to make a power-on approach. This will give you a lower approach speed and better control."

CHEVRON AVIATION GASOLINE

RPM AVIATION OIL

STANDARD OIL COMPANY OF CALIFORNIA

Skyways Round Table

(*Continued from page 36*)

flight where his skilled proficiency varies? There are many factors which can cause it to vary: sleepiness, anxieties, fatigue, preoccupation, distractions, irregularity of working hours, cockpit ventilation, etc. I believe the industry must take a square look at the factors which cause efficiency variations."

Jerry Lederer: "*With that we're getting into the field of Dr. Seitz. Would you care to comment?*"

Dr. C. P. Seitz *(Deputy Dir., H.E. Div., Special Devices Center, USN):* "This area is one that people often ask questions about, and to which, unfortunately, there are no good answers. Organizations often ask us how they can tell which of the people they employ are going to come in late in the morning. How can one tell ahead of time who are going to be misfits in an organization? In many cases where such personnel problems arise the individual in question meets standards in other respects: they are good workers; they produce the product in satisfactory quantity and earn their pay. I think this is similar to the case Capt. Shapiro is talking about. The pilot meets the standards of the CAA and his airline, but fails in some undetermined way when the chips are down. I don't think there's any ready answer to that problem because the variables are such that one can't assay the significance of any particular accident situation. We only conjecture when we say fatigue, anxieties, preoccupation, etc., are related to the accident problem.

"Basically, what we need at this time is called, 'Systems assistance analysis.' If we made an analysis of all the problems that we're facing here and gave them their relative importance in the whole picture, we would find out that some things are more important than others, and we'd be able to spend our time in solving the problem in a way which would allow us the biggest gain.

"It's fairly obvious to us in the Special Devices Center that we could build training gadgets for almost anything conceivable. But some kinds of training are going to pay off and some aren't. We have to spend some money to find out what it is that deserves training as against that which doesn't deserve training, and give priority to the development of those items.

"Summing up, we have individually contributed in this Round Table significant concepts and ideas that we've learned through experience. These ideas and concepts lose power, however, because there are so many. We need to examine these separate ideas and determine the contribution each makes to the solution of our problem. This process of analysis is sometimes called systems or operations analysis and requires the talents of specially trained and oriented groups. Until we do a system analysis and orient our activity, we will be hopeless wanderers."

Jerry Lederer: "*Going back to Capt. Shapiro's comment about distractions, fatigue, etc., you say there are no solutions. But wouldn't a possible 'fix' be monitoring?*"

Dr. Seitz: "Certainly, it would help. Overtraining helps, too. To illustrate that point—after we built the first operational flight trainer, engineers learned how to improve their design and they gradually introduced more and more refinements. I'm thinking particularly of what we sometimes call 'peripheral simulation.' We began to simulate clouds, wheel squeak on landing, icing conditions, etc. It was even suggested that we include snow and sleet. We have resisted that thus far, though we do have lightning. From the point of view of learning, you might ask yourself, 'what does the pilot learn by having bright lights flash to simulate lightning?' From an emotional point of view, you're supposed to be frightening him in the cockpit when you flash bright lights. However, he knows that isn't lightning and you're not scaring him. Presumably, you feel that he's going to get some idea of what the differences in visibility are in the cockpit.

"Basically, we feel you're going to do a better job if you take whatever it costs to include these simulated features in the trainer and spend it for additional training.

"A learning curve is an 'S'-shaped curve. It starts off fairly flat at the beginning, then goes up rather steeply as the man begins to learn, and then flattens out again and further effort doesn't seem to yield additional progress. The learner has reached 100% performance and he can't get any better. That's what the graph or curve tells us, but from the point of view of learning there is what psychologists call 'over-learning.' Though you cannot achieve performance greater than 100%, it is possible through extensive practice to fix a task to be learned so well that time and other interfering conditions do not prevent you from reproducing it. In a sense we build up a learning reserve.

"In much of our training in flights simulators we discontinue practice when we reach 100% learning, that is, just as the learning curve flattens out. Since we can just barely do the job, an emotion-producing situation such as a lightning storm can cause our performance to fall below the 100% mark. If we had invested some additional time and allowed over-learning, then come lightning, hell or high water, we would have had a learning reserve and it is less likely that our performance would be effected.

"From our point of view, therefore, over-learning is a better way of solving this problem than by adding 'peripheral realism.'"

Cmdr. David Crockett, USNR *(Traning Officer, NAS, Floyd Bennett Field):* "Four or five years ago the Navy set up a Board at each air station for the purpose of preventing accidents. Called the Accident Prevention Board, it is made up of the training officer, operations officer, flight surgeon, and maintenance officer. The commanding officer of the station is an alternate member. Anyone may attend their meetings and bring any discussion before them they desire.

"We've found there are two things which can lead to accidents: one is complacency, and the other is lack of regular training. In some cases, the crew is well trained and the pilot may have been at one time, but when an emergency arises, he's not prepared. Here are some examples of these accidents:

"About three weeks ago a fighter pilot in the organized reserve (he was an airline pilot in civilian life) returned from a gunnery flight and requested permission to make a couple of touch-and-go landings. On the second touch-and-go he failed to shift to the tank which had gas and at an altitude of about 50 ft. his engine quit. He ended up in the sand on his back.

"Here's a regular airline pilot doing a simple job of flying and he failed to go over his check-off list and ended up out of gas.

"A couple of months ago a P2V took off from one of the Naval Air Stations, reached an altitude of about 500 ft. (at that time there was a ceiling of 300 ft.) and the pilot detected engine trouble. He immediately called GCA and started a return. He missed his first approach and on the pull-up, due to lack of coordination between pilot, copilot and plane captain, the plane was unable to maintain altitude and crashed, killing four to six members of the crew.

"The Board investigated and determined 1) the copilot did not know his job, 2) the plane captain had been performing his duties for him, 3) this crew had had no single-engine procedure drills together in this particular type of aircraft.

"I don't know whether the airlines, the CAA or the Air Force have similar Boards

Dear Declaration

It is too bad that Americans are today not born free and equal: free of debt and equal to taxes.

Hy Sheridan

"COMPLACENCY *and lack of regular training can lead to accidents," says Comdr. Crockett*

to discuss various problems and try to prevent accidents before they happen, but we feel if you have crew coordination and do have an emergency, the operation machine isn't going to break down. I would suggest that the crew simplify its job by learning as much about the subject as possible. All standard and emergency procedures should be studied and practiced until efficiency is obtained."

Allan Williford *(Vice Pres., Gen'l Mgr., Link Aviation):* "Several people have mentioned the need of what I would call 'forming good habits.' I think Dr. Seitz will agree that most anything we human beings do under stress or emergency is a habit. If we cultivate good habits, when that emergency arises, we can expect to do properly that which should be done. An Air Force pilot who deals with high Mach number aircraft told me recently that unless the boys knew instinctively what to do in an emergency, they were gone. I hope you will pardon what sounds like sales talk but there is only one way to learn emergency procedures with any degree of safety and that's in a simulator-type of trainer. In addition to the safety of the individual, the money cost of putting a plane into the air, doing the maneuver you want and then coming down is too high when compared with the cost of doing the same operation time after time in a trainer. And it's absolutely necessary, if you're going to formulate good habits, to repeat the maneuver time and again.

"Capt. Shapiro mentioned earlier that in one year the chances are their pilots would have an opportunity to make only two or three instrument landings at Chicago. How on earth can you expect a man to develop proficiency in making instrument landings at any one station if he does only two a year? The danger of instrument let-downs in bad weather in high density teminal areas has been pointed out, but it can be done repeatedly and safely in these training devices. More than that, there is the problem of the maintenance of proficiency. No matter how good you are technically, you can only maintain that proficiency by performing everyday.

"The opportunity for either the commercial airline pilot or the executive pilot to maintain this proficiency and work out emergency problems, either individually or as a crew, seems to require these training devices. The big obstacle is cost. To get suitable trainers we're going to have to spend hundreds of thousands of dollars. These are highly complicated electronic analog computers which require engineering and hardware almost equal to the simulated aircraft itself. There are some who've questioned whether the military or the airlines can afford these trainers for the value received. The management of the airlines and the military will have to answer that question. However, there are big chunks of money spent for indirect use in connection with flying military or commercial service, and I believe that the benefits from the safety point of view, not to mention the economic savings, should be given lots of consideration."

Dr. Richard C. Dehmel *(Chief Engr., Curtiss-Wright Corp.)*: "There are really two kinds of training to be derived from the synthetic training equipment that Mr. Williford speaks of. One is procedure training and the other is operational training. Relatively inexpensive equipments are available for training and practicing radio procedures as they apply to instrument flight and navigation, including approach procedures at specific airports. Operational training may comprise (a) transition and (b) training, and this is accomplished in a simulator which is an exact duplicate of the aircraft itself with respect to configuration, equipment and performance. In transition, the pilot and crew are taught the details of operating a new or different airplane. Steps in this process are cockpit familiarization, feel of control response, crew coordination and emergency procedures. Important dollar savings are to be realized by the use of the simulator in each of these phases. In addition, flight safety through emergency-procedure training can be accomplished better in the simulator than in the actual aircraft. Means are provided in the simulator for artificially introducing virtually every conceivable trouble which a crew may

(Continued on page 40)

THEY NEED YOU
A typical interview...
where Embry-Riddle students are pre-selected for essential, good-paying jobs in aviation even before their training is completed... they step right into their jobs as soon as they graduate!

...AND YOU CAN QUALIFY IN SIX MONTHS!

Embry-Riddle offers you complete 6-months to 2-year courses... **NOW!**

YOUR CAREER IS WAITING!

The high regard of Embry-Riddle training by the leading airlines and the entire aviation industry is demonstrated *time and again* by the big demand for Embry-Riddle graduates.

There's an important high priority job in aviation waiting for you...however, if you do enter the services, Embry-Riddle training will definitely give you rating advantages. Thousands of Air Force men are Embry-Riddle trained.

AIRCRAFT & ENGINE MECHANICS
Vast numbers of properly trained A & E Mechanics are urgently needed. Our C. A. A. approved school with a quarter-century experience assures your quickest advancement! Embry-Riddle students learn fast with modern equipment, including jet...live aircraft, airline-size hangars.

AERONAUTICAL DRAFTING AND DESIGN
Embry-Riddle's accelerated 12-mo. Aeronautical Drafting and Design Course provides finest training available. Technicians with management responsibility enjoy highest salaries!

COMMERCIAL PILOT
Embry-Riddle trained pilots benefit from our years of experience with 30,000 students. the best instructors, up-to-date aircraft, superb year-'round flying weather Also Instrument and Instructor's ratings.

A & E COMBINED WITH COMMERCIAL PILOT
Airmen with *dual* pilot-engineering ability are needed by aviation companies and operators. Embry-Riddle combination training offers you the most in your aviation career

Training authorized under the G.I. Bill.

CLASSES ARE BEGINNING NOW...SEND THIS COUPON TODAY!

Embry-Riddle International SCHOOL OF AVIATION MIAMI 30 FLORIDA

Dean of Enrollments – Dept. 93
Embry-Riddle School of Aviation
Miami 30, Florida

Please Print

NAME _____
ADDRESS _____
CITY _____
STATE _____ AGE _____

I am interested in...
☐ A&E Mechanic
☐ Commercial Pilot
☐ Aeronautical Drafting and Design
☐ A&E Combined with Commercial Pilot
☐ A&E Combined with Private Pilot

Check One ☐ Veteran ☐ Non-Veteran

TRAIN IN MIAMI -- AIR CAPITAL OF THE WORLD

Skyways Round Table

(*Continued from page 39*)

encounter in the flight of an airplane.

"After indoctrination of a crew to a new aircraft, the simulator is particularly useful in proficiency training. This comprises routine checking of personnel and restoration of proficiency in techniques and procedures not encountered in day-to-day flying. The simulator is an exceptionally opportune tool for the pilot, copilot and flight engineer's very extensive training in emergency as well as normal operating procedures. The actual aircraft affords the flight crew very little opportunity to analyze engine or accessory malfunction, since it is not practicable in the actual aircraft to create any appreciable variety of engine or aircraft difficulties.

"The difference in simulator requirements between the military and commercial operator are slight. The airlines seem to emphasize radio-aids training and so purchase more extensive radio simulation. The military veer off to a greater degree in the direction of radar interception simulation and the like.

"The training costs of both the military and the commercial airlines reach huge dollar values. Military training costs are many, many hundreds of millions of dollars a year. Airlines training costs are many tens of millions. Simulators seem now to have reached the point where they've proven that they enhance safety possibly more than any other single training medium can do. Capt. Scott Flower of Pan American Airways reported after a year of flight-simulator operation that it not only saves money but provides (1) realistic training and (2) broader limits for determining safe operating procedure and techniques than the actual aircraft itself. This airline has conclusively shown a reduction from a mean of 12.6 hours aircraft transition time to a mean of 4.02 hours. This corresponds to large dollar savings. CAA allows the simulator in partial application to six-months checks.

"We have made an analysis of the savings which the military may anticipate from simulator procurement as forecast for the next 15 years. This amounts to over $10,000,000,000.

"From the standpoint of enhancing safety, simulators afford an excellent medium for evaluating new and different kinds of flight instruments, cockpit arrangements, radio and navigational facilities.

"These ground devices have one of their most powerful applications in the field of emergency-procedure training. Various kinds of equipment failures have caused aircraft accidents or near-accidents. These troubles are easily included in the simulator and their repetitive introduction gives the pilot and flight engineer the experience required to quickly recognize the nature of the failures and subconsciously take corrective action. So I think, in considering the aspects of improved flight safety, that a very careful and real look should be taken at these ground training devices."

D. G. Erickson: "There is one portion of crew coordination which I think we've missed thus far, and that's how any crew in any aircraft spends its time in necessary book work, necessary communications, and looking for and seeing other airplanes.

"In the past four years we've had some 76 mid-air collisions. Only one of these occurred at night (an air carrier over-took an airplane that was not lighted), the balance of them occurred during the daytime. Not a single one of those accidents happened during instrument conditions. That means we had 152 airplanes with their crews who had reasonably good conditions in which to sight other airplanes and yet they didn't see them.

"A very important part of this crew coordination is to try to find some way or means in a larger airplane to see to it that somebody is *always* looking out."

D. G. Peterson: "The point I'd like to make is, what if we do see another plane? The rule tells us how to give way, but you don't have time in the present high-speed aircraft to do what the book says. I had such an experience over Wichita, Kansas, in my own private plane; there was nothing I could do but shove the nose down quick. I'm wondering if something shouldn't be done to call the crew's attention to some method other than the normal giving way to other traffic.

"My experience was with a T-33 jet trainer at about 2 o'clock, as far as position was concerned, and at the same level. He came out of an overcast, probably two or three miles ahead of me. I was talking to the Tower at the time. Had I instantly seen him

"FLIGHT SIMULATORS *help prove emergency procedures," Dr. R. C. Dehmel explained*

when he came out of the clouds and had he seen me and had we given way in the normal fashion, we still could have come together. As it was, I ducked down—that's all I had time to do. He went over the top of me . . . and very close.

"It takes a long time to turn an airplane, and the larger the airplane, the longer the time it takes to turn. But an airplane can go up or down rapidly. Would it be possible to develop some sort of a rule on giving way, basing it on size, speed and maneuverability of an airplane?

"I've had the idea the slower or the more maneuverable airplane should go down. Our pipeline pilots operating over bases such as Tinker Field in Oklahoma City, for instance, might meet one of the boys out doing a buzz job. If it's a jet, the pilot isn't going to shove the nose down—he'd be in the ground too fast. If it's a Cessna 140, the pilot can shove the nose down from 200 ft. and still recover safely.

"We can't all go up or all go down, so I wonder if some thought shouldn't be given to such a procedure."

Jerry Lederer: *"Could you simulate a near-collision in a Dehmel trainer? That would be part of crew training and probably very necessary."*

Dr. Seitz: "Present trainers are primarily for instrument work, not for contact flight. Collision avoidance is consequently hard to simulate.

"I'd like to suggest a practice which is used in operating ships and lighter-than-air craft. The Navy has look-outs, a person who's assigned the job of 'watch.' If the problem is as serious as you say it is, 76 mid-air collisions in four years, it may be desirable to establish formal watches. This doesn't necessarily mean the hiring of more people; it's just that someone will have to be given the responsibility of *always* looking. At the present time, it's an informal matter, everybody is supposed to watch or look as often as he has a chance to look. But if they all get busy and put their heads in the cockpit, then nobody's looking."

D. G. Erickson: "Along that line, some of you surely have experienced near-misses when flying in VFR. If you're in an airplane that travels five miles a minute and meet another airplane traveling at the same rate, even if it's 1,000 ft. above or below you as it should be, it's surprising how many times they can sneak up and be very close to you, as far as your position head-on is concerned, without you ever seeing it.

"I think having people anonymously report incidents which occur in flight is a good idea. You can hardly talk to a pilot who hasn't had some very close calls, and yet very few reports are sent to us."

Jerry Lederer: *"I think John Groves is an expert on that."*

John Groves: "That has been a terrible problem around here. You say it hasn't happened at night or they don't happen on instruments. I say they're happening both at night and on instruments; it's just that we don't see them then.

"One thing I think will help is the light that Carl Christiansen of United Air Lines has come up with. It's a light that eventually will be installed on all our aircraft. They're supposed to be in use on all airline planes

(*Continued on page 42*)

7000 FEET

When you choose your own airplane bear in mind that you want top performance at altitude—for as you go higher you gain many benefits—smoother air, better gas economy, superior VHF radio reception, much easier navigation and added safety. The 1953 Tri-Pacer gives you an added advantage at altitude—you cruise faster as you climb higher.

With better than two-mile-a-minute sea-level cruise at 75% power, the Tri-Pacer's cruising speed steadily increases to maximum at 7,000 feet. Up to 14,000 feet your cruising speed is still greater than at sea-level. This is an important advantage. That's why pilots in South America, in the Rocky Mountain states and in Alaska will invariably say that Piper's the better airplane at altitude where you want to fly. Better on take-off, better in climb, faster cross-country. Remember these points when you select your airplane.

And in the 1953 Tri-Pacer many fine new improvements have been added *all at no increase in price.* Whether you judge the Tri-Pacer by price or performance, you'll inevitably decide it's the best buy in aviation today. See it, fly it at your Piper distributor's.

YOU GET THESE TOP FEATURES IN THE SENSATIONAL NEW 1953 TRI-PACER

More room and comfort for four passengers
More baggage space with outside door • 135 HP Lycoming
Greater useful load • New beauty and styling
Tricycle gear and simplified controls • Duraclad finish

Also the Model PA-20 Pacer with three-point gear

For Your FREE full-color brochure on the new 1953 Tri-Pacer and Pacer just write Dept. K-2.
PIPER AIRCRAFT CORPORATION
Lock Haven, Pennsylvania

PIPER Aircraft Corporation Lock Haven, Pennsylvania

MORE PEOPLE HAVE BOUGHT PIPERS THAN ANY OTHER PLANE IN THE WORLD

Skyways Round Table

(*Continued from page 40*)

this winter, but it may not be until next year."

Jerry Lederer: *"Let's ask Bob Buck and Capt. Shapiro what they would do to reduce the collision hazard. Do you insist that no paper work be done during climb and descent and do you have a man watching out?"*

Capt. Shapiro: "Yes, and as a matter of fact United Air Lines has that written into the manual; however, I don't believe the individual pilots realize the seriousness of the problem. Information about this collision problem, the fact that there were 76 in the last four years, should be directed to the pilots. There's a wide gap between writing a regulation and having that regulation followed in the cockpit. If a regulation has no significant meaning or if it doesn't make an impression on the mind of the individual, chances are it's not going to be 100% followed. If you had a means of impressing upon the pilots the problem behind the regulation, I believe you'd find close to 100% acceptance.

Jerry Lederer: *"Capt. Shapiro, I think you're getting into the matter of attacking complacency."*

Capt. Buck: "We have exactly the same rule in TWA—that there be no paper work in the climb and descent. Personally, I enforce it, and that goes for mental paper work, too.

"One of our pilots, an ex-Navy man, reasoned that inasmuch as he'd flown formation on instruments and had been able to see the other aircraft in formation with him, maybe in airline operations on instruments he could see enough of another aircraft to avoid a collision. Using that as a basis, he always maintained a watch while the plane was on instruments. Not long ago, he took off from Paris at night, climbing on instruments. He saw another transport on instruments and avoided it. Checking back, we found it was an ATC error. They had an airplane in the wrong place at the wrong time. The important point, however, was that the pilot saw the other plane and he was on instruments. It pays to look out even if you're on the gauges."

Dr. Seitz: "In this connection it seems that people who are trained to watch, as this pilot undoubtedly was, do better than those who are just casual watchers. Perhaps this looking out ought to become part of training."

Capt. Ueltschi: "I'd like to say one thing. I recommend that we all try to get radar departure around such congested areas as Washington and New York. Radar departure is very useful and helpful. They can tell you where the other aircraft are, even in smoky conditions."

John Groves: "The only trouble is that you've got no altitude information."

Capt. Ueltschi: "Yes, but at least we know when there's something near, and in which direction to concentrate our 'watch.'"

D. G. Erickson: "Radar will tell you there is an airplane and where it is in relation to you, but it's true—you don't get their altitude. After they've already warned you about the other airplane, you spend two or three minutes finding it. We can't make it too impressive that we must keep a constant watch for aircraft."

D. G. Peterson: "Going back to mental attitude, I think our Approach Control operators and Airway Traffic Control centers should realize more fully what goes on in the cockpit—the mental attitude of the one who's trying to copy a clearance. Even the airlines ask for repeats on clearances. I've heard the Tower repeat a clearance three or four times . . . and very fast, too. Finally, they do slow down, but if the pilot or whoever is copying the clearance has that much trouble getting it, his mental attitude isn't going to be good. If I'm getting a clearance and it's complicated, I tell them to give it to me slowly, that I'm going to copy it down. Usually, they do so very graciously.

"We have the same thing on arrival. If a stranger comes into an area he hardly knows and gets a different routing on his arrival than he expected, he's going to be busy looking in the book to see where these points are. I think on arrivals it would be simpler if they would clear us to a point and tell us where to expect clearance beyond that point. In other words, we may be cleared to Flatbush here at LaGuardia, but we don't know whether we're going to be cleared on to New Rochelle or what it might be. As far as mental attitude is concerned, if something were done to simplify the plan, it would make it easier to copy, easier to follow and the mental attitude would be better.

"Maybe that's not a problem with the airline pilots who are familiar with the areas, but I certainly think it is a problem where corporation pilots are copying complicated clearances. Radar departures *have* helped."

***"REPORTS** of incidents or near-accidents would be helpful," Mr. Erickson stated*

Capt. Shapiro: "This takes us back to one of my original questions. Do the pilots have the necessary tools for their job? For example, when you receive a departure clearance from New York to Chicago, if you had a Jeppeson chart and a plastic overlay where all you had to do was trace your clearance on the plastic (over the chart)—you could trace your departure course and crossing altitudes—wouldn't that be a better tool than trying to write the clearance down in longhand?"

D. G. Erickson: "Following along that line, I had a rather exciting experience recently. We came into this N.Y. area with low visibility and ceiling, and shortly after we landed, I requested another instrument clearance back to Washington. Because of traffic, they gave us a very involved clearance. We copied it all down, got the manuals out and saw just what it was. We were ready for take-off and were cleared, but just after the wheels were off the ground and I'd called for gear up, they voided our clearance and gave us a completely new one! Boy, that was a lulu, particularly with a copilot who was not familiar with the area."

Capt. Shapiro: "If you had a visual reference, such as this area map with a plastic overlay, positioned in the cockpit where everyone could see it, you could have drawn in your new clearance."

Jerry Lederer: *"Is the pictorial computer any answer?"*

D. G. Erickson: "It would be a big help because all you'd need to know would be at what altitude you're going to cross any point. A pictorial computer shows you where you're headed and exactly what your track is. Normally, your fixes would be marked out, so it would be very simple."

Capt. Ueltschi: "Jerry, you brought up the problem of complacency, the pilot's attitude and Management's responsibility. Our organization, Flight Safety, Inc., has been working with many corporation pilots. These men come to us because they want to. The CAA has no regulation requiring them to be checked like airline pilots . . . and I hope they never do. All of the pilots we have worked with have a wonderful attitude and they take pride in their work. They have accepted the principle that in any profession training is never completed and that maintenance of skill is achieved through continuous training rather than through examinations or checks. As Capt. Custer suggested, we have designed this program to assist them. We have experienced people go out to find ways to help the pilot and copilot, not to check up on him.

"We believe in training the crew in the control of emergencies and in performance limitations under all conditions. The safest crew might not consist of the hottest pilots. A well-coordinated team of average pilots can do a much better job of flying and handling emergency conditions than two hot pilots who do not have the best cockpit coordination."

Capt. Buck: "Another thing that might fight complacency is good dissemination of all

accident reports to all pilots. Such a report should have the essential points on it. The CAB reports are too long."

John Groves: "I think it's a fine idea, but the trouble is it takes about six or eight months to get anything official on accident reports out of the CAB. In the ATA we have a plan whereby whenever we have an accident of significance, we send out a man to make a report of that accident. It is cleared with the company and goes out as a confidential memorandum for the airlines in ATA so that they get a preliminary report within a week or 10 days. This, however, is not an accurate assessment of what happened. If we could get those CAB reports sooner, it would be a much better system."

Allan Williford: "This discussion has all been on military, commercial or corporation pilots, and not a thing has been said about the private pilot, probably one of the greatest sources of danger in the air. I mean the private pilot who hasn't any instruments and doesn't know much about flight rules. Just last week a pilot at Link was flying on instruments and a private pilot came flying at him right out of the overcast. The two didn't hit, fortunately. But a committee of CAB people who were in our plant a few days later came to the conclusion that the only thing you could do about that kind of private pilot was, to use their expression, scare the bejeezus out of him. Perhaps private pilots need closer regulation."

D. G. Peterson: "What can we do about this danger of head-on collisions? If we could just suggest a means of collision avoidance! I'm convinced that at least one out of 70 accidents could have been eliminated if the crew hadn't been frozen in their tracks, wondering what to do, knowing that it takes too long to turn the airplane because they were too close before they saw it."

D. G. Erickson: "Let's see if I understand you correctly. I got the impression from what you said that if two planes are on a collision course at the time of recognition, it's too late to do anything about it."

D. G. Peterson: "Well, too late to do anything about it as the book prescribes today. I advocate another procedure: that the smaller and slower ship should go down; the larger and faster ship should go up. If the large plane goes up and the small plane ducks down, it's a quick movement. If two airplanes are on a head-on course on the same level, it takes too long to turn away as per the book."

Capt. Shapiro: "The problem there is that the smallest airplane may not always be the slowest."

D. G. Peterson: "Performance would certainly have to be considered. Perhaps the thing to do is in some way emphasize to the individual pilots that there is another way they can take so-called 'evasive action' even if it's not a regulation; that it's just an understood policy that if you don't have time to do anything else, the smaller or slower plane ducks down and the larger or faster airplane goes up."

D. G. Erickson: "The present rule is that the plane turns to the right. It seems to me what you're suggesting involves an additional amount of time. For example, if you see another plane coming at you, you have to

LINK'S *Allan Williford suggested need for closer regulation of private pilots*

decide whether you're bigger or he's bigger before you go up or down."

Capt. Shapiro: "Don't you feel that the instinctive reaction to the situation will overcome any rule that's written? I had one coming in from 2 o'clock on top of an overcast at night in a holding pattern. We instinctively reacted immediately. There was nothing we could do but pull up."

Dr. Seitz: "Don't you think that the trouble is there are too many rules? Every time something happens, we correct it by writing new rules and regulations. We talk about cockpit loads, that's part of the problem—there are too many regulations."

Capt. Shapiro: "That's an interesting observation. Many scheduled airline pilots feel that, due to the multitude of regulations, they are becoming skilled workers and losing all identity with the phrase, 'Airline Piloting Profession.'"

D. G. Peterson: "Well, here's another one of my pet ideas. Instead of using a long proper name for a compulsory reporting point or holding point, let's use short ones. Anybody can copy one syllable without trouble, but if you try to copy a long name . . . !"

Dr. Seitz: "What you say is well based on actual and experimental fact. During the war, the Air Force and Navy did a lot of research in this business of speech intelligibility. There is no question about the fact that we can measurably increase the intelligibility of radio communication using the gear we have right now, if we do certain things. These things involve 1) how the talker talks, 2) how the listener listens, and 3) what the content of material is that's being communicated.

"One of the basic things the military researchers came up with is standard patter; standard phrases, standard words for communication. Standard procedures and patter for communication are important aids to safety. They decrease the time needed to communicate by providing short ready-made talk and they increase accuracy of communication because the listener, knowing the patter, is able to fill in the message that is lost in transmission."

D. G. Erickson: "I'd like to go back to this Tower business, if I may. It's quite a problem. We had an incident under VFR conditions about three weeks ago. I reported over a range station. They told us we were #2 to land behind a DC-6 airliner. We had a west wind and were cleared to land on Runway 33. The airliner landed, cleared the runway, and about that time we were coming in over the river on the final approach. Our plane was a Twin Beech and we were pretty close to full gross; hadn't used much gas. I had a slight crosswind and didn't want to land too slowly. When I was at an altitude of about 50 ft., the Tower told me to land short and not cross Runway 36. Another airliner was coming in on Runway 36 and the Tower told him to land short on 36 and not cross 33. So there I was . . . an airliner coming in behind me; I was coming in with power because of a good load, had to land short and not cross the intersection. I didn't have time to look around, and I knew that if he overshot and I overshot, we'd both arrive at the intersection at the same time. I had no reversible props, but I knew I had to get on the ground and really stop. Well, I put the ship down on the runway and hit the brakes. When I finally stopped, I just had room to turn without going into Runway 36. When I turned and looked down the runway, the airliner had just stopped rolling. I guess it was about 1,000 ft. away. Now that's close. The whole thing was a mistake. It was just fortunate it didn't turn out to be serious.

"If both planes had elected to go around, it could have been very bad. Or if either of us had radio failure or hadn't been listening, it could have been a bad situation. The Tower made a serious mistake in asking me to stop short. After all, a Twin Beech isn't like a car—you just don't push a pedal down."

Capt. Shapiro: "I'd say the basic cause of the mistake from the Tower was that the operator didn't understand the capabilities of the aircraft."

Jerry Lederer: "Time is running out on us, gentlemen, and in closing this discussion, I'd like to take a few minutes to highlight the points brought out. Apparently, our needs are many.

1. There's the need to provide pilots and crew members with better 'tools' to handle their paper work, especially navigational and approach information.
2. The need to give the 'why' of a regulation or requirement so that the crew can readily understand the reason for it, and thus 'sell' themselves on the need to comply.
3. The need to avoid implications of the word 'check' in pilot and crew checks.

(*Continued on page 44*)

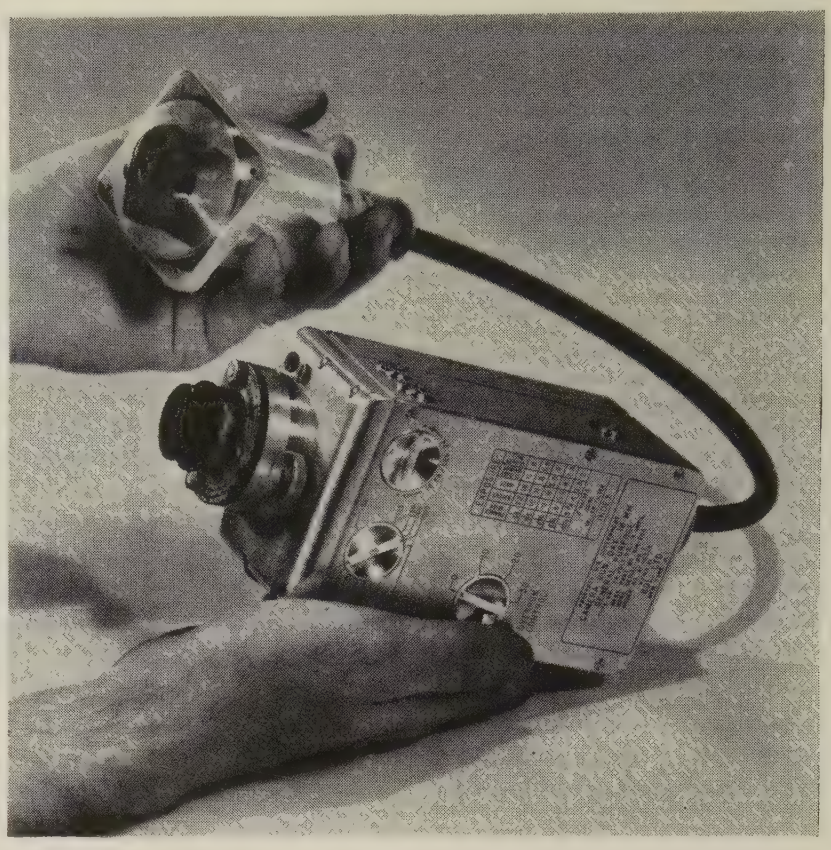
Skyways Round Table

(*Continued from page 43*)

The philosophy should be one of assistance, helping crew meet requirements.

4. The need for securing and disseminating promptly information on lessons learned from accidents.
5. The need for training crew members as coordinated members of a team as well as training them individually.
6. The need to resort to monitoring each other, without loss of leadership in the captain, especially when crew members may be subject to anxieties, distractions, preoccupation, complacency, fatigue.
7. The need to put crews through emergency requirements as outlined in the Manuals to determine the realistic practicability of the routines.
8. Need to ride with crews on routine flights to determine their acceptance of established requirements.
9. The need to provide crew members with an outlet to report near-accidents from which much can be learned.
10. The need to obtain better communications between crew members.
11. The need to recognize the special needs of corporate pilots who fly everywhere —they lack familiarity with fixes, control tower dialects, etc. The ideas proposed at this meeting were to use single-syllable words to denote fixes, to describe fixes to pilots (by control tower), and to have the control tower 'slow-up' on their departure instructions so those instructions can be copied.
12. The need for better vision, for training crews in 'looking,' for establishing a 'watch' at all times, and for training oneself in advance as to what one would do if a collision were imminent (actions depending on types of ship meeting each other). Pilots should be given statistics on collisions.
13. The need for maintaining competence on instrument approaches, perhaps by making as many instrument landings as possible to keep efficiency up.
14. The desirability of using simulators to learn emergency procedures with safety; the tremendous financial savings resulting, therefore. Also stressed were the advantages of over-learning as against 'just getting by.'
15. The need to make a systems or operational analysis of the training problems to determine priority as to which specific tasks are paramount to the solution of the problem of crew assignment and preparation.

"With recognition of these needs, perhaps now we can concentrate and channel our efforts to the satisfying of those needs and to the attainment of improved safety in operations."



BOLSEY N-9 *high-speed camera for U.S. Air Force shoots up to 64 frames per second*

BOLSEY N-9 CAMERA

Speed is not for jets alone. The U.S. Air Force recently received preproduction delivery of the famous Bolsey N-9, a recording camera so fast that it can be synchronized to the firing mechanism of 500-mph jet combat aircraft.

Remote-controlled and operating at lightning speeds, the Bolsey N-9 shoots pictures automatically when the jet plane's guns start firing, and records not only actual combat but also the results, as the picture-taking continues for a given time after the firing ceases. Operating up to 64 frames per second, the N-9 can "freeze" the action of jet planes which, when moving in opposite directions, may develop relative speeds of more than 2,000 mph. The remote-control instrument box which is set on the instrument panel of the plane can, by the flip of a finger, adjust the variable shutter of the camera to compensate for variations in light conditions. To make adjustments, the pilot simply turns the control lever to the elementary settings, "hazy," "dull," or "bright."

The N-9 is small, about the size of a hand, and uses 16-mm black and white or color film in 50-ft. magazines. The camera is built to withstand 25 G's or more and has met all tests of 65° below and 160° above Zero.

Commercial adaptation of the N-9 would provide airline operators and airport developers with an instrument which would give them an accurate picture of ground approach and take-off hazards and would be invaluable in charting new routes. Too, the camera might well serve for regular check purposes, increasing the safety factor in air transport.

The Bolsey Corporation of America recently was awarded the *U.S. Camera Award* for its outstanding work in the development of the N-9. Jacques Bolsey, president of the corporation, has been engaged in research development and design for the U.S. Air Force since 1949.

After Korea . . .

After World War II, many young men turned down the opportunity to take advantage of training offered under the GI Bill. Many of these have since seen service in Korea and now wish they had not passed up the fine training they could have had. Are you one of these?

You Still Have That Opportunity

Now that veterans of Korea have that opportunity, don't make the same mistake again. The proper training can still help you to catch up with and progress faster than those not having proper training.

Let Spartan School of Aeronautics Show You the Way

The training received at SPARTAN has helped thousands of young men to advance further and faster than they could possibly have hoped for without such training. Hundreds have been able to progress to top-notch positions in aviation. There is a place waiting for you and SPARTAN can train you — in the least possible time — to achieve success in aviation.

No Correspondence Courses

DON'T PUT IT OFF

If you put off taking training now, you will probably never have the opportunity again. Don't you be among those who fail! Let SPARTAN COUNSELORS show you — without obligation — what GI benefits are due you and what aviation training can do for you.

SPARTAN
A UNIVERSITY OF AVIATION
SCHOOL of AERONAUTICS — COLLEGE of ENGINEERING
MAXWELL W. BALFOUR, DIRECTOR — ADDRESS DEPT. S-23
TULSA, OKLAHOMA

Maxwell W. Balfour, Director
Spartan School of Aeronautics Dept. S-23
Tulsa, Oklahoma

Please send your free Catalog immediately.

Name_____ Age____

Address_____

City_____ State____

Indicate which of these branches interests you:

- ☐ Flight
- ☐ Instruments
- ☐ Mechanics
- ☐ Aeronautical Engineering
- ☐ Radio
- ☐ Airline Maintenance Engineering
- ☐ Meteorology
- ☐ Management and Operations

Spartan is approved for training under the G. I. Bill of Rights

VHF Navigation with RMI

(*Continued from page 15*)

in the foregoing is usable only when a known compass course has been followed from point of departure. Relative bearings are of small practical use by themselves. In order to be useful, they must be tied to a geographic reference. The bearing given by the direction finder loop is relative to the airplane nose, which is to say, airplane heading at time of obtaining the bearing. Since the relative bearing is the angular difference between the magnetic heading of the airplane and the magnetic bearing of the station from the aircraft, it follows that the relative bearing indicated by the direction finder may be added to the magnetic heading of the aircraft (magnetic compass indication) and thus provide a magnetic bearing from aircraft to station. (*See Fig. 1.*)

When plotting a position fix, particularly when position is unknown, it is much more convenient to use station-to-aircraft, rather than aircraft-to-station, bearings. It is apparent that a station-to-aircraft magnetic bearing is the reciprocal of its corresponding aircraft-to-station magnetic bearing. When obtaining a fix by use of cross-bearings, the pilot holds a constant heading while obtaining relative bearings to at least two radio stations. Each relative bearing is first converted to a magnetic bearing and then to its reciprocal, emerging as a station-to-aircraft magnetic bearing. A compass rose is placed on the map at the first radio station location with its zero aligned with magnetic north. A line is then drawn on the map according to the respective station-to-aircraft magnetic bearing. A similar procedure is followed for the second station, and usually for a third station. Upon plotting these bearings on a map, a triangle will be formed. The pilot can approximate his position only as near the resulting triangle.

If it is desired to use "true" bearings, they may be obtained by correcting magnetic bearings for variation.

Greater accuracy and convenience in plotting a fix may be obtained by use of a Radio Direction Finder Chart for Aeronautical Use (DF Chart) prepared by the U. S. Coast and Geodetic Survey. Superimposed around each radio station (low frequency) is a compass rose which has been corrected for variation. These roses show magnetic bearings. Around the outside of the compass roses, in large print, are indicated the magnetic headings into the station. On the inside of the compass roses are printed the magnetic headings away from the station (the reciprocal of the inbound course). Therefore, when a DF chart is used, the magnetic headings can be plotted directly without need for calculation of reciprocals. Still greater accuracy may be realized by making corrections for meridian convergence and magnetic deviation as described on the DF chart.

Automatic Direction Finder

Efforts to reduce the time interval required to obtain a relative bearing resulted in the development of the automatic radio compass or Automatic Direction Finder (ADF), as it is familiarly known. This equipment includes a rotatable loop, a sensing antenna, a radio receiver, and an azimuth scale to indicate loop position with reference to the longitudinal axis of the airplane. It has, in addition, a loop motor mechanism for rotating the loop, and loop control circuits for automatically controlling the loop motor mechanism.

★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★

The Old Man Tests Jets

They may not have much hair on their heads, but they have it on their chests, those fellows who test the supersonic jets. When we visualize a supersonic cowboy, we think of a young spalpeen abusting out with libido of all kinds, a reckless knight of the lofty joust. Not so, not so. The ones who dare to test the latest nightmare of the engineers are men old enough to know better. Perhaps therein lies their usefulness. The gummit wants them back long enough to file the report.

Anyway, at White Sands a bald-headed supersonic jet test pilot had just sallied through the sonic barrier like it was made of, say, chiffon, and he was being interviewed on the scene by a number of U.P. and A.P. and wire reporters. The test pilot was telling his story in a matter-of-fact manner, although the facts had become hair-raising indeed (albeit seemingly not to him) when a new type jet came cracking out of the dome of heaven, whistled between a couple of hangars, and then pulled up for a series of loops within loops. Then it floated upside-down for a landing, turning rightside-up just before touchdown.

"Who in h . . l is that damned fool?" the reporters exclaimed.

The bald-headed supersonic test pilot smiled apologetically.

"Oh," he said, "that's Pa, blowing off steam again."

Note to thunderstorm flyers:

If you don't keep the wings on your airplane, you'll get 'em on you.

—Hy Sheridan

★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★

In the ADF there is a mechanism which automatically rotates the loop to a null position. To "home" on a station, the pilot tunes in a station while using only the sensing antenna. He then switches to operation whereupon signals from the loop and the sensing antenna combine to cause automatic rotation of the loop so that it faces the station to which the receiver is tuned. A remote-indicating synchro system drives a pointer on the 360° azimuth scale to indicate the direction in which the loop is facing. The line on the scale marked zero, like the lubber line on a magnetic compass, indicates the longitudinal axis of the airplane and represents the nose of the airplane. To "home", the pilot merely steers the aircraft to bring the indicator pointer to zero—radio station dead ahead—and keeps it there until the station is reached. The 180° ambiguity is automatically resolved in this equipment. Upon passing over the station, the pointer will swing 180° to show that the station is now to the rear of the aircraft. In this respect, the ADF acts in the manner of a "bird dog" and is often called by that name.

It is apparent that use of the ADF obviates manipulation of the loop and, therefore, cuts down on the time required to obtain a relative bearing, thus reducing the "is-was" error. Also, use of the ADF makes it unnecessary to perform an orientation maneuver in order to resolve the 180° ambiguity of the loop. Equipments mentioned thus far, however, can indicate but one station at a time, thus creating a time lag between the bearings obtained. A fix made in this manner is known as a "running" fix and its accuracy is affected thereby.

By providing two complete ADF systems feeding a single indicator having two pointers, each pointer being operated by its respective ADF system, it is possible to obtain simultaneous cross-bearings, *i.e.* to obtain an "instantaneous" fix rather than a running fix. This equipment, aptly called Dual ADF, permits a large reduction in the so-called "is-was" error. Advantages and additional uses of dual pointers as compared to single pointers are readily apparent. For example—one ADF system may be tuned to a station dead ahead for homing purposes, while the other system is available for obtaining cross-bearings. After plotting a position fix, another fix is plotted a short time later. The pilot can determine the mileage, note the time of travel, and can then compute a ground speed. Again, taking a cross bearing on a station while flying a low-frequency range leg will give a pilot, with reasonable accuracy, his position on the leg. Other uses mentioned briefly include true bearings for continuous fix, position along track flown, orientation, heading, visualization of aircraft position between two stations, straight-line track through two stations.

The next advancement was fairly obvious. Magnetic radio bearing is obtained by adding relative bearing to magnetic heading. By shifting the azimuth scale to indicate magnetic heading, the loop pointer will indicate magnetic radio bearing directly when read against the azimuth scale. Many indicators used with ADF and Dual ADF systems are provided with such settable azimuth scales. With this refinement, a fixed reference is mounted on the case of the indicator at the normal location of the scale zero. This is called the zero index. If the scale zero is

(*Continued on page 48*)

tune your OMNI to...

AERO COMMANDER

DEPENDABLE ESSO AVIATION PRODUCTS!

You've got your Omni range needle on dead center when you're homing on the famous Esso Wings. Flying executives, private plane owners, commercial airline operators all know the sign of dependable service and high quality Esso aviation fuels and lubricants.

They choose Esso Aviation Products, backed by constant research at America's largest petroleum research laboratory and proved by over 43 years of actual flying. They prefer Esso Dealer Airports, staffed with trained, experienced operators for top service with products that give top performance. You can depend on Esso Aviation Products!

Next trip take along an Esso Aviation Credit Card. There's new convenience in charging:

- Lubrication, tire and battery services.
- Landing fees.
- Overnight storage in transit.
- Minor emergency services.

Esso
AVIATION PRODUCTS
SOLD IN: Maine, N. H., Vt., Mass., R. I., Conn., N. Y., N. J., Penna., Ohio, Del., Md., D. C., Va., W. Va., Ky., N. C., S. C., Ga., Fla., Ala., Miss., Tenn., Ark., La., Texas.

TO GET THE ESSO CO-PILOT — a complete directory of Esso Dealer Airports, write Esso Aviation Products, Room 428, 15 West 51st St., New York 19, N. Y.

VHF Navigation with RMI

(*Continued from page 46*)

set to the zero index, the arrow head of the azimuth pointer reads the azimuth angle of the radio station relative to the heading of the aircraft, just as with a fixed azimuth scale. By manually rotating the scale so as to place the aircraft magnetic heading at zero index, the arrow head of the pointer will read magnetic bearing from aircraft to station directly if that heading is maintained accurately while bearings are read. Under these conditions, the tail end of the pointer will read the reciprocal, *i.e.* the magnetic bearing from station to aircraft. On this and subsequent equipments, the indicator pointer forms a diameter of the azimuth scale, having an arrow head at one end. It is standard practice to allow the arrow head to point toward the station.

ADF—Magnetic Indicator

The next step was fairly obvious but was dependent upon availability of the remote-indicating magnetic compass for its attainment. By connecting the settable scale of the ADF indicator so as to be controlled by the remote-indicating compass, the scale will indicate continuously the aircraft magnetic heading as read against the zero index. This combination continuously indicates the magnetic heading of the aircraft, the magnetic radio bearing, and the relative radio bearing. Generally speaking, this instrument is a Radio Magnetic Indicator (RMI), but it is well to think of the particular version described at this time as the ADF-Magnetic Indicator in order to prevent confusion later on. With this instrument, the arrow head of the pointer always reads bearing of aircraft to the station, and the tail of the pointer reads bearing of station to aircraft. Magnetic heading of the aircraft may be made true by setting in the magnetic variation on the remote compass system, or on the settable azimuth scale.

Nearly all later models of indicators provide automatic correction for quadrantal error with no mathematical computation.

The big advantage of the ADF has always been its simplicity of use in visually indicating the direction of the radio station. It is very useful for orientation on radio ranges, establishing a heading on a range leg with crosswind, homing approach procedures, radio fixes, etc. ADF now is almost a universal navigation instrument in aircraft of any size that fly "all weather."

Direction finding equipments described thus far utilize ground radio stations within the frequency range of 100 to 1800 kc. The VHF omnidirectional range (VOR) has several advantages over the low-frequency four-course range, and is in general use at the present time. However, a selected course to or from an omni station, an aural leg on a low-frequency range, or a localizer course for an instrument approach are position devices and, as such, are position sensitive only. For a given geographic position within any one of these facilities, indication is the same regardless of aircraft heading. They cannot be flown without some reference to a secondary heading in the aircraft, usually the magnetic compass. To put it another way, the airplane is always flown by heading, and position must change in space before the indication of a position device will indicate any change.

A pilot inexperienced with instrument approach on a localizer forgets that the needle is not heading sensitive—that it is only *position* sensitive. He must take a definite heading, fly it for an appreciable time, and wait for something to happen on the position needle. Similarly, in flying an aural low-frequency leg, he must take a definite heading, fly it for an appreciable length of time, and listen to the change in the tone that he hears as his position changes. He cannot do this to perfection and the wind direction and velocity may not be known; consequently the process known as bracketing was developed to enable a heading to be established which would maintain the proper course. A similar procedure is used in bracketing and arriving on a localizer or omnirange course as is used for a low-frequency range leg.

However, this is rather difficult to do because rate of approach to course and crosswind must be taken into consideration. The pilot needs experience and training in order to be able to do it accurately and quickly. He must anticipate either by the rate of change of background tone on a low-frequency range or by rate of movement of needle on a localizer or omnirange. To repeat, the real basic reason for the great success of the ADF was because it is "heading sensitive." It requires no bracketing, and no special training for use. The airplane is merely turned until the pointer indicates that the airplane nose is pointed toward the station. By maintaining this indication, the pilot flies directly over the station. The ADF is also used for other simple orientation and low approaches. True, the plane may not make a straight-line path over the ground to a station, but the pilot always gets there and he knows where he is pointed. Even when lost, no complicated orientation procedure, such as used on low-frequency ranges, is necessary. The pilot merely turns on the ADF, the needle points to the station, and he knows where he is with reference to the station.

ODR—Magnetic Indicator

It would seem that the omnirange, just as the low-frequency range, would not be completely successful for "all weather" flying unless a secondary instrument associated with the omnirange bearing information was made "heading sensitive"—that is, pointed to the station at all times in the manner of the ADF.

The omni station sends out information which gives magnetic bearings "to" or "from" the station. The omnibearing selector and deviation indicator tell airplane location on a specific bearing or "radial" line, but tell nothing about the direction in which the airplane is headed. In other words, the omnirange provides magnetic bearing from aircraft to station (omnibearing) directly, but without relation to aircraft magnetic heading.

As mentioned before, relative bearing is the angular difference between the magnetic heading of the airplane and the magnetic bearing of the station from the aircraft. That is to say, magnetic bearing is the sum of relative bearing and magnetic heading. Adding relative bearing to airplane magnetic heading thus provides magnetic bearing from aircraft to station. The ADF-Magnetic Indicator displays relative bearing at the arrow

COMPONENTS OF THE BENDIX NA-3A VHF NAVIGATION SYSTEM WITH DUAL RMI

Unit Name	Bendix Type No.	Weight lb.	Weight oz.	Over-all Dimensions Width (in.)	Height (in.)	Length (in.)
Remote Control	MN-81	2	0	3.00	3.00	4.50
Omni-Bearing Selector	MN-82	1	8	3.25	3.25	4.656
Course Deviation Indicator	ID-48	1	9	3.25	3.25	3.670
VHF Receiver	MN-85	27	10	5.00	7.62	25.25
Shockmount	MR-74	3	4	5.875	4.00	23.75
Power Supply	MP-74	9	12	5.06	7.50	9.53
Omni-Bearing Indicator	MN-69	1	11	3.25	3.25	4.50
Radio Magnetic Indicator	MN-72	1	11	3.25	3.25	4.00
Radio Magnetic Indicator Amplifier	MN-89	4	0	2.84	4.06	7.20
VHF Navigation Antenna	MS-192	5	12	17.19	12.06	25.75

head of the pointer with reference to the zero index (airplane nose), and aircraft heading as read on the scale at the zero index—thus providing magnetic bearing from aircraft to station as read by the arrow head of the pointer against the azimuth scale.

To provide a similar "heading sensitive" display of omnirange information, it is necessary to obtain relative bearing from aircraft to omni station. According to the formula, relative bearing is the angular difference between magnetic heading of the aircraft and the magnetic bearing of the station from the aircraft. Therefore, by transposition, subtracting the airplane magnetic heading from the omni-magnetic bearing provides relative bearing, which is the same bearing shown initially by the ADF. (*See Fig. 2*) If this operation is done continuously and automatically, the omni-magnetic bearing from aircraft to station is converted to a relative bearing and will drive an indicator pointer to always point toward the station, just as in the ADF. Actually, omni-magnetic bearing information from the navigation receiver and airplane magnetic heading information from the remote-indicating compass is fed continuously to a "computer," whose output then continuously and automatically drives the pointer of a radio magnetic indicator to show relative bearing from aircraft to omni station at all times. If the position of the settable azimuth scale of the indicator is controlled from the remote-indicating compass, just as in the ADF-Magnetic indicator, the indication obtained from the ODR-Magnetic indicator will be identical to that of the ADF-Magnetic indicator.

As a matter of fact, the dual indicator used for ADF may often remain in the aircraft; the omni receiver then feeds one pointer and the ADF feeds the second pointer, or the pointers may be switched to any combination of omni receivers or ADF receivers. It is advisable to arrange such an installation so that a given ADF or ODR unit is always associated with a given pointer, otherwise an unnecessary change in practice and thinking is required. With this arrangement, depending upon type of station used, the indicator could be indicating simultaneously on two ADF's, two ODR's, or one ADF and one ODR, as desired. The type of indication obtained would be identical regardless of type of station selected.

The radio magnetic indicator as associated with the omni receiver has done a great deal to insure the success of omni ranges because here again is that "very simple to use" ADF-type indicator where the pointer is heading sensitive and all of our information is on one instrument, namely, the pointer points to the station, the heading is at the top of the instrument, and the bearing to the station can be read at the pointer. The same ease of orientation is available as with the ADF. In fact, an ADF has been created on VHF.

Bendix NA-3A RMI

Possibly the largest attractive feature of the present-day VHF navigation system car-

(*Continued on page 50*)

if you will answer these 3 simple questions YOU CAN SAVE $1.00 on your new or renewal subscription

Please clip and return

The Editors of SKYWAYS want your help. Answer these questions, subscribe now or extend your subscription for one year for $3.00—regular price $4.00. You save $1.00.

1. In what capacity are you connected with aviation?

Position_____

Company_____

Nature of Business_____

2. In what type of editorial subject are you most interested?

_____

_____

3. Do you subscribe to SKYWAYS or buy it at the newsstand?

Subscribe ☐ Newsstand ☐

Editor, SKYWAYS
444 Madison Avenue
New York 22, New York

In accordance with your above offer, please enter my subscription for one year at $3.00.

Name_____

Address_____

City_____ Zone_____ State_____

New ☐ Renewal ☐

2-53

VHF Navigation with RMI

(*Continued from page 49*)

ried aboard corporate and airline aircraft, aside from the advantage of freedom from static encountered on low frequencies, is its extreme flexibility. To illustrate, a user may install a VHF navigation system with "minimum instrumentation" for basic utilization of airway navigation, instrument landing, and communications facilities currently available between 108 mc. and 135.9 mc. Various accessory equipments may then be added to the minimum system according to the instrument flight needs and desire of the user, up to and including automatic pilot with automatic approach. (VHF Navigation with the OmniMag, *Skyways* December 1952.)

Heretofore in this article we traced the development of the "heading sensitive" indication for low-frequency radio facilities, culminating in the ADF-Magnetic Indicator. The need was then expressed for a similar "heading sensitive" indication for very-high-frequency radio facilities, exemplified by the ODR-Magnetic Indicator. It was mentioned that the actual indicators for ADF-Magnetic indication and ODR-Magnetic indication are identical. Therefore, if Dual ADF-Magnetic indication is already available in the aircraft, the addition of a VHF navigation system will allow the same indicator to be used for ODR-Magnetic indication. A selector switch may be installed so that ADF or ODR can be connected to either pointer or to both pointers (by use of a Dual VHF system).

The following material will describe briefly the components which comprise the Bendix NA-3A VHF Navigation System with Radio Magnetic Indicator (RMI) and which is shown in the block diagram (Fig. 3). This equipment is manufactured by Bendix Radio, Division of Bendix Aviation Corporation of Baltimore, Maryland. Units designated by an asterisk (*) are considered to be normal airplane instrumentation for instrument flight and are not a part of the NA-3A system *per se*. These units are, however, essential to proper operation of the system.

The Bendix Type MN-85 VHF Receiver is a modern superheterodyne covering the frequency range of 108 mc. to 135.9 mc. and incorporating circuitry allowing full utilization of communications, VOR and VAR navigation, and tone-type runway localizers. All frequency selection and navigation data presentation is accomplished from remote positions. The 280 channels in the VHF band are controlled by 34 crystals in a "crystal saver" circuit, thereby minimizing the number of crystals required while allowing full realization of crystal-controlled frequency stability.

Navigation circuitry is included as an integral part of this unit. Since various types of navigation facilities are allocated portions of the VHF band, frequency selection automatically includes switching of the proper navigation function into activity. Normal manual VOR circuitry, involving use of Omni-Bearing Selector (OBS) and Course Deviation Indicator (CDI), is complemented by use of the Radio Magnetic Indicator (RMI) for continuous bearing indication to or from the VOR station. Provisions for operation of the flag alarm circuits of the CDI is an integral part of the MN-85. The receiver is mounted in a Type MR-74 Mounting Base having clamps for securing the receiver, vibration absorbers and an electrical connecting receptacle.

The Bendix Type MP-74 Power Supply is designed to convert the 26.5 volt d.c. aircraft primary supply to operating voltage for the MN-85 Receiver. The MP-74 is equipped with a detachable mounting plate which is fastened permanently to the aircraft.

Room with a View

In the window of United Air Lines' Los Angeles office, there's a 4-foot model of a DC-6 Mainliner. One side of it is made of transparent plastic to show the interior arrangement. A young lady recently approached Vaughn Bennion, UAL's office manager, and asked,

"Does it cost extra to sit on the plastic side of the plane? I always like too see where I'm going."

The Type MN-81 Remote Control is a concentric knob frequency selector wherein the actual frequency selected appears in a display window. The Bendix Radio Da-Nite system is used to illuminate the numbers, presenting bold white numerals in daylight and red numerals in darkness. Several models of this unit are available: switch and knob assembly mounted on a small panel; switch and knob assembly with third concentric knob operating volume control; switch and knob assembly mounted in a rectangular box with cable receptacle.

The MS-192 VHF Navigation Antenna is horizontally polarized, designed for reception of the VHF navigation and runway localizer signals. Its design permits broadband non-directional performance while incorporating an aerodynamic design minimizing drag. Provision of a relay and associated vertical antenna permits reception of vertically polarized signals.

Selection of desired bearing to or from the VOR station is accomplished by manual adjustment of the Type MN-82 Omni-Bearing Selector (OBS). Such adjustment is made by means of a knob at the right side of the instrument face and the bearing is read directly in numbers appearing on a "veeder-counter" type mechanism at top center of the instrument face. A "To-From" indicator at lower center indicates, depending on airplane location with respect to the station, whether the selected bearing is "to" or "from" the station. An additional switch is included which is used for instantaneous switching to a reciprocal course. This switch changes the bearing indication in the above-mentioned counter to the reciprocal and automatically reverses the "To-From" indication. Any deviation of the airplane position from the selected bearing line is indicated by deflection of the associated "cross-pointer," which is the ID-48 Course-Deviation Indicator. Bearing accuracy of the MN-82 OBS used in conjunction with the MN-85 Receiver and ID-48 is better than plus or minus three-fourths of 1°.

The Type ID-48 Course Deviation Indicator (CDI) is an instrument having two cross-pointers in the conventional manner, one vertical and one horizontal. In the NA-3A System, the vertical pointer indicates course deviation in conjunction with VOR, VAR, or ILS. The horizontal pointer is intended for glide path indication and must be activated by equipment not included as a part of the NA-3A System. This would be the proposed new Bendix Glide Slope Receiver (or equivalent), associated frequency control, and antenna. Flag alarms are included for both pointers of the CDI. These alarm flags appear over the end of each pointer to warn the pilot that inadequate signal is available for proper operation, or that the pointer is not in operation.

The Type MN-69 Omni-Bearing Indicator (OBI) accepts electrical data from the automatic indicator portion of the MN-85 Receiver and converts such data to visual continuous indication of omni magnetic bearing from aircraft to station. In addition, this OBI includes facilities for combining omni bearing data with electrical information from a gyro-stabilized remote-indicating compass (not part of NA-3A System) to make possible a "heading sensitive" indication on the MN-72 Radio Magnetic Indicator. It will be remembered that subtracting the airplane magnetic heading continuously and automatically from the omni-magnetic bearing provides a relative bearing for driving an indicator pointer to always point toward the station, just as in ADF.

The Type MN-72 Radio Magnetic Indicator (RMI) accepts omni bearing and magnetic electrical data from the OBI and converts it to a pointer indication equivalent to that of the standard low-frequency ADF. The azimuth card is automatically rotated by electrical data from an amplifier fed by the remote compass. The zero index or reference marker near the top of the instrument indicates airplane magnetic heading when read against the azimuth scale. The VOR-driven pointer, as read against the azimuth scale, indicates the magnetic bearing from aircraft to station. To "home" on an omni station, the pilot merely steers the aircraft to bring the indicator pointer in line with the zero index and keeps it there until the station is reached. In a dual indicator, as shown here, the two pointers are electrically independent and each may derive its driving power from a second VOR installation or a low-frequency ADF.

As ordinarily used, the remote-indicating

magnetic compass is capable of operating its master indicator and one repeater indicator. It is necessary to amplify the compass output to a sufficient power level for driving the RMI azimuth scale. The Type MN-89 Radio Magnetic Indicator Amplifier is utilized in the NA-3A System for this purpose. Briefly, the azimuth scale is driven by a motor connected in a servo control circuit, as against the simple synchro circuit used for each pointer.

The remote-indicating magnetic compass system usually comprises three units 1) sensing unit for determining airplane position relative to the horizontal component of the earth's magnetic field, 2) compass amplifier for modifying and amplifying sensing unit output, and 3) compass master indicator for presenting airplane magnetic heading.

A junction box, not part of the NA-3A System, forms a convenient method for effecting unit interconnection.

The VHF Receiver, Glide-Slope Receiver, and Power Supply, along with the Compass Amplifier and RMI Amplifier, are placed on a shelf in the radio compartment, or other convenient location having environment suitable for electronic equipments. The compass sensing unit is usually located in a wing tip, airplane tail section, or vertical stabilizer. All indicators are mounted on the pilot instrument panel, or suitable location nearby.

Antennas are secured to structure on the fuselage centerline, usually forward of the wing.

Component weights and over-all dimensions are given in the accompanying table. All units are provided with quick-disconnect electrical connectors for ease of unit installation, removal, and servicing.

Inasmuch as the foregoing material is largely self-explanatory and method of use of navigation and communication facilities are so very well known, it is felt that detailed description of system operation would be rather superfluous. Accordingly, we offer here only brief mention of fundamental system operation.

With electrical power supplied to the system, it is merely necessary to manipulate the two concentric knobs on the Remote Control to a position which causes the frequency (direct reading in megacycles) of the desired facility to appear in the display window. The system automatically tunes itself. Aural identification of the facility is then obtained.

Basically, VOR navigation information is presented to the pilot by the CDI cross-pointer instrument in which a vertical pointer is at center when the aircraft is directly on the desired course. This course may be the track of a runway localizer (ILS), a leg of a "visual-aural range" (VAR), or a radial of a visual omnirange (VOR) selected by the omni-bearing selector (OBS). The aircraft is maintained on the desired course by steering left or right of the approximate magnetic heading as required to keep the vertical pointer centered.

When a VHF omnirange is selected on the receiver, any desired course to or from the omni station is selected by rotating the Course Set knob at the right side of the OBI face until the selected course is indicated by figures in upper center of the instrument face. Whether this bearing is "to" or "from" station, depending upon airplane location with respect to station, is automatically shown by the "To-From" indicator in lower center. An adequate signal for system operation is evidenced by absence of the vertical pointer flag alarm. When the airplane is on this selected course, the vertical pointer of the CDI is at center; when the course is to the pilot's right, the vertical pointer is to his right; and when the course is to the pilot's left, the vertical pointer is to his left.

On final approach, the Glide-Slope Receiver is tuned to the operating frequency of the desired facility. Absence of the horizontal pointer flag alarm then indicates an adequate signal. Use of the horizontal pointer for glide-slope tracking is conventional.

Whenever a radio facility is received by the VHF Receiver, the OBI will indicate continuous magnetic bearing of aircraft position to radio station, regardless of aircraft heading. The associated pointer on the RMI will indicate relative bearing from aircraft to station—the zero index may be visualized as the airplane nose and the arrow head of the pointer points toward the station. Azimuth scale as read against zero index provides airplane magnetic heading, arrow head of pointer read against azimuth scale indicates magnetic bearing from aircraft to station (track *to* the station), with pointer tail indicating reciprocal bearing (track *away* from the station). To fly directly toward the station, the pilot steers the airplane so as to align the arrow head of the pointer in this position until the station is reached. In brief, the RMI when used with very-high-frequency facilities is usable in the same manner as the RMI when used with low-frequency facilities.

While the reader may be aware of the value of the RMI with its ease of interpretation, it is hoped that the foregoing material has correlated some of the factors involved in its development and has demonstrated its flexibility when incorporated in the present-day VHF navigation system.

COMPONENTS *that make up Bendix Type NA-3A VHF navigation system are shown here*

Work Plane of the North

(*Continued from page 17*)

highway, cat-trains track in fuel. When the first bush plane sets down gingerly and its pilot gives the word that it's OK, the crews move in beside the strip.

In the northern bush country the fly-boys (most of them working for the oil companies) talk excitedly about their vastly expanded status. Next to oil itself, the pilots are the most pampered prima donnas in the bush. They're pampered because, despite its table-land flatness, the muskeg has a nasty habit of swallowing up veteran pilots.

But one thing a visitor notices as he pokes around the pyramidal-tent hangars and gropes through the lung-searing deepfreeze, is the frequency with which that term "eager beaver" is tossed around. When Chief Pilot Cull talks about "eager beaver", he means his single-engined de Havilland *Beaver*, which has become the work plane of the Canadian Arctic.

Hundreds of oil explorers drop their work and run like happy Ferdinands when Cull and his buddies let down for their twice-a-week calls at isolated camps. Oil crewmen know that the flyers bring mail and grub, and the little "extras" which have kept their morale high-pitched through some of the most hellish working-weather men have ever endured. In all this, the *Beaver* has earned a name synonymous with "pack animal."

"Two things count up here," said Bill Simpson, who with Cull and Gordon Cameron, fly California Standard Co.'s two *Beavers*. "Most important, we've got to have a ship that can sit down anywhere and get off its belly again, whether on skis, wheels or floats. And we've got to have a combination job that can haul both cargo and passengers, and keep packing them in and out without loosening rivets or blowing cylinders or needing long maintenance layoffs. The *Beaver* qualifies all the way around."

The *Beaver* isn't the prettiest ship in the air. But neither is the sure-footed mountain mule the shapeliest beast of burden. But the all-metal *Beaver* can pack a pilot and five passengers, or fewer passengers and plenty of cargo in its 125-cu. ft. "hold" aft of the pilot. The rectangular struts which brace the *Beaver's* 48-ft. wing span are rugged. The ship is stressed to 5¼ g's and is built to withstand gust conditions up to 66 feet per second and diving speeds to 215 mph. Able to withstand severe exposure when moored in the open, the *Beaver's* airframe is treated with corrosion preventatives, both internally and externally.

The *Beaver's* 450-bhp Pratt & Whitney *Wasp Junior* engine allows full power from sea level up to 5,000 ft. The engine drives a Hamilton Standard constant speed prop.

Before de Havilland locked up the final designs, it queried bush pilots from one end of Canada to the other. Eighty-five per cent of the bush flyers responded, laying out what they considered essential in a top-flight bush craft. Foremost among their recommendations were: (1) sturdy construction and rugged dependability; (2) ability to take-off and climb out of tiny lakes and rivers; thus super take-off and initial climb performance; (3) big cargo capacity and (4) low-cost operation.

Incidentally, *Beavers*, somewhat modified and designated L-20, are being produced for the USAF and U.S. Army and have seen service around the world, including Korea.

Price of the *Beaver* standard landplane is $29,000. As a bush plane, complete with floats, skis, radio and customary extras for north country operations, the ship costs about $39,000 plus duty and taxes.

Under normal conditions, with a 12-mile wind, the *Beaver* seaplane takes off the water in 12.8 seconds with an all-up weight of 4,820 lbs. Take-off performance at full load under maximum adverse conditions—zero wind—is 15.5 seconds in 795 ft. The ship stalls at about 45 mph when fully loaded, and with flaps down, power off.

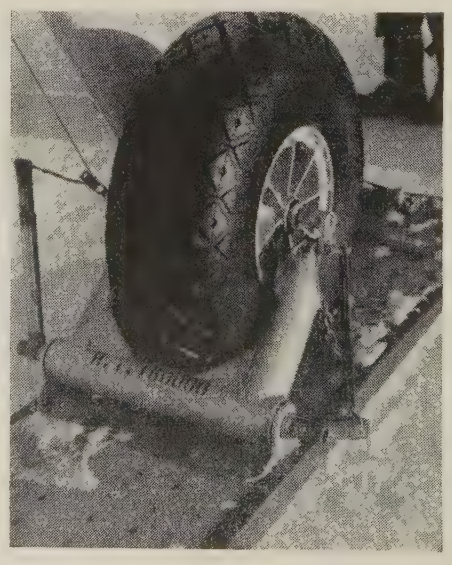
Maximum rate at sea-level climb for the floatplane *Beaver* is 1200 fpm; for the landplane, 1,290 fpm. Its range varies from 200 to 630 miles. Typically, the landplane hauls payloads ranging from 1600 lbs. at 200 miles to 1,230 lbs. at 630 miles.

The *Beaver* has a "throw-over" control column, dual rudder pedals, and hydraulic flaps and brakes. The latter work by toe-pedals on the rudder control.

Designed into the plane are several special "bush" features. Cabin doors are 3 ft. 3 ins. wide so that a 55-gallon gas drum can be rolled into the cargo hold. There's an additional 9 cu. ft. baggage compartment aft of the rear cabin wall for an emergency bush kit.

Since there are no heated hangars at most of the airstrips, the *Beaver* sits out in the worst weather. One morning, as we prepared to leave Peace River for the muskeg camps, I watched as Alf Taylor, an old Arctic hand, readied the ship. He ran flexible tubing from a gasoline-engined heater to the canvas cover which was pulled tightly over the *Beaver's* engine and prop. As the engine warmed, he and Cull pulled hemp rope along the wing surface, knocking off ice and frost. When this operation was finished, they removed the canvas and reved up the engine. It sounded a little throaty at low speeds, but quickly smoothed out as Cull stepped up the rpms.

SKI BRAKE, *developed by Taylor and Cull, gives pilot control of skis on icy strips*



It was surprising how much cargo the *Beaver* could take. A California Standard Co. truck pulled up alongside and a couple of men started loading. We took on a radio, a lot of canned goods, a couple of sides of beef and some automotive parts.

"This is a regularly scheduled flight," Cull explained, "we've got this operation on an airline schedule. We have six camps and we visit them at least twice a week, or more often if they're desperate for something."

At this point Alf Taylor cut in, "These *Beavers* are an A&E's dream," he said. "They give very little trouble." Alf is one guy who should know. He's spent most of his life doctoring planes in the Arctic. He'd ridden the MacKenzie Air Service's Fairchilds and Beachcrafts as mechanic when their pilots winged north over the Arctic Ocean on once-a-year mail deliveries to such isolated spots as Coppermine, on Coronation Gulf.

Once, somewhere over Alclavic, Alf had to climb out on a Fairchild's wing when a short between the generator and the control box set fire to the cabin's kapok packing. The pilot's feet were roasting and there wasn't room for the two of them in the ship, so Alf grabbed an extinguisher and retreated to the strut. They got the fire out, but Alf's posterior was fast frozen.

Under Alf's experienced hands, the *Beavers* get their periodic overhauls (every 30 hours; then again at 60, 90 and 120 hours) with a complete tear-down inspection at 300 hours. Engines are removed every 600 hours and sent to the factory for overhaul. Props are changed during the 600-hour inspection. Outside of that, and daily routine checking, not a lot goes wrong.

Alf is proud of the home-made ski brakes he and Cull concocted to give the *Beavers'* skis some control on the icy muskeg strips. They've equipped the ships with manual brokes, manipulated from the cabin, each with its separate control. A cable runs to a rod, which in turn jabs an 8-inch brake arm into the ice. It is a simple contrivance, but highly effective in everything but soft snow. Altogether, including cables, the brakes adds only 5 lbs. to the ship's weight.

Finally, when everything was loaded, and after Dick had spent fully 20 minutes checking the ship out, we gunned off the Peace River runway and were airborne in a hurry. For the next two hours we cruised along at an Indicated airspeed of 115 mph, an actual airspeed of 125. Dick explained that skis air-drag a good 15 mph off actual airspeed. Floats knock the speed down even more.

De Havilland claims that the floatplane will consume 19.8 gallons per hour at 60% power. Where a bush operator like Cull

makes a lot of short flights of around 100 or 150 miles, the consumption is higher—about 21.5 to 24 gph. On long ferry flights, *Beavers* have consumed as little as 18 gph. Dick Cull said his experience jivved pretty much with the company's claims of performance.

About two hours and nearly 250 air miles out of Peace River, Dick contacted a base camp's UHF radio and we set down on a one-way strip. Dick spun the ship around and we taxied back to where some gasoline drums were cached. There was a truck standing by to unload us, and meanwhile Dick and an oil crewman hand-pumped fuel into one of the three filtered inlets lined up on the *Beaver's* port side. Pretty soon we were fueled and off again. Half an hour later we arrived at a side camp. The camp was equipped with a rare luxury, a windsock. When Dick got down, shut off the engine and went into the cook shack for coffee, he agreed to leave me there a few days so I could watch the oil operation.

"We're just a taxi service and a freight barge combined," Dick laughed. "And the *Beaver*, by golly, can do both jobs at once."

Dick explained over a cup of coffee that even though we'd stayed at 6,000 ft. most of the way, altitude wasn't particularly important over the muskegs. "There aren't any air strips to speak of anyway, and if you have to land you might as well come in from 2,000 feet as 6,000. As far as picking out a spot, they're all about the same. The real problem up here is what happens after you land—especially if it's 50 below zero and you're out of radio contact."

He was thinking, of course, of veteran bush pilot Johnny Bourassa (an ex-mail flyer, holder of the DFC and Bar) who disappeared in May 1951 on a routine flight from Bathhurst Inlet to Salmita Mines (150 miles north of Yellowknife). It wasn't until September that an Air Force B-17 crew accidentally spotted Bourassa's plane intact, anchored at the edge of Wholadaia Lake. They found a note saying that he'd started out on foot May 23rd at 2:30 p.m. with the intention of walking in a northwesterly direction toward Ft. Reliance on Great Slave Lake. Ground parties searched every cabin along his probable trail but no trace of Bourassa was ever found and finally the search was abandoned.

When Dick finished his coffee, he loaded aboard the *Beaver* a couple of oil crewmen who were heading back to civilization for a 20-day vacation. He waved "good-bye," reved up the engine, let go the brake and shuttled down the icy strip. Long before he ran out of runway the *Beaver* lifted like a fat, stiff-winged Hawk moth and soon was just another grey speck over the muskegs.

A California Standard executive from Calgary was in camp that day. When I turned away from the fleeting speck that was Dick's *Beaver*, I discovered the oilman standing a few feet behind me.

"Well, there goes one of our 'eager beavers,'" he said. "We'd have a tough time keeping this muskeg operation going without them."

Tale with a Happy Ending

The Air Force pilots are to be provided with a new comforting device. It seems that when an Air Force pilot has to fly a lot it makes his . . . . er . . . . a . . . . tokus tired, and this is said to interfere with his efficiency. So, resourceful engineers are providing him with a cushion which will massage aforesaid fundament. (Your modest reporter suggests that the device be named the Hokus Pokus Tokus.)*

It is not known just how the device is to work, in a mechanical sense at any rate, but it is thought to consist of air tubes which alternately inflate and deflate, heaving like the chest of a deep-breathing blonde in a fur store.

We airline pilots do not need the Hokus Pokus Tokus. When we get into an airplane, we're glad to sit down and just rest it.

Hy Sheridan

(Inspired by the rumba)*

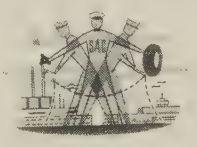
Facts and Figures!..

Figure:

This luscious, long-stemmed figure last fall earned its owner, Flame-Haired, Blue-Eyed Pat Blake, the title "Miss Lusty Girl of Texas." Also, the Variety Club voted hers the Most Beautiful Legs in Dallas, a decision backed unanimously by an informal panel of pilot-judges reviewing the case on Southwest Airmotive's front porch. Pat — all 19 years, 5' 7", and 122 lbs. of her — joins us in wishing you and yours many happy landings in 1953!

Fact:

America's leading manufacturers have entrusted their distributorships to Southwest Airmotive Company. They have found in SAC an aggressive, imaginative, square-dealing teammate. In this spirit, SAC proudly — and completely — represents such famous names as ARC, Bendix Products Division, Bendix Scintilla, BG, B. F. Goodrich, Champion, Eclipse Pioneer, Hamilton Standard, Pratt & Whitney Aircraft, Wright Aeronautical, and many others.



Southwest Airmotive COMPANY
LOVE FIELD | DALLAS

Pilot's Report...Tri-Pacer

(*Continued from page 12*)

informed, however, that Piper offers a choice of altimeters and any new owner can have just about what he wants.

It seemed to me, too, that the stabilizer adjustment control, which is situated conveniently overhead, should display some mark to indicate a neutral position.

Another thing a pilot new to the *Tri-Pacer* must become accustomed to is the nose dip when the engine is being run up before take-off. It drops down the oleo strut about three to four inches as power is applied, but all it is is action of the nose wheel shock-absorbing unit.

On my first approach at Morristown, I facetiously called for "gear down." Strohmeier, riding beside me, said without hesitation: "Gear down—and welded."

Well, it doesn't matter much that the *Tri-Pacer's* tricycle gear is fixed. The important thing is that it is a tricycle gear. That makes it easier to land under normal conditions, and it is particularly good when the wind is kicking up. I landed the *Tri-Pacer* in a 32-mile, 65° wind at Teterboro. Crosswinds take-offs with the *Tri-Pacer* should be made in the same manner as normal into-the-wind take-offs, except it is generally good practice to hold the nose wheel on the ground somewhat longer.

The growing use of instruments in single-engine business-type aircraft has resulted in much more attention to instrument panels. The *Tri-Pacer* has what Piper calls a "flight-planned" panel. It has been carefully designed so that it is adaptable to almost any combination of instruments desired, including artificial horizon and directional gyro. The basic panel has room for 12 instruments, plus holes for the gyro instruments. Three different face plates are available, one for standard instruments, one for the primary group or the primary group plus a directional gyro, and one for both gyro as well as primary and standard instruments. The net result is an excellently designed and uncluttered instrument panel.

Piper has increased by 18% the usable space within the cabin. I always have trouble getting into and climbing from lightplanes because I am not exactly the thin man, but once inside the *Tri-Pacer* there is plenty of shoulder and leg room. The rear seat also has been widened and my two pudgy passengers back there agreed that they had no feeling of being crowded at the shoulders. While I'm discussing that rear seat, I want to point out that there are individual adjustable ventilators for good circulation on hot days.

One other good feature of the *Tri-Pacer* is that there is now someplace to put your hat. Above and back of the rear seat is a deep, roomy rack that will take four hats, a camera and other small items.

Piper focused a lot of attention on the task of reducing engine noises and related vibrational disturbances and coping with the problem of wind shrieks stemming from increased speed. There is a large stainless steel exhaust muffler and the cabin is completely surrounded by an envelope of heavy Fiberglas. There is a double thickness of the same material on the fire wall and cowling. Sections of the fuselage near the engine have been sprayed with automotive-type, sound-deadening material. To deaden resonance, a pad of quilted material has been placed forward of the instrument panel. The heavy-gauge Plexiglas windshield and windows have been sealed tight to help in noise reduction.

Piper very obviously had the businessman pilot in mind when the *Tri-Pacer* was modified this year. By modifying the welded steel structure aft of the cabin, a much larger baggage compartment has been built into the 1953 model. Space has been increased from six to 12.5 cubic feet. The compartment can be reached through a large-size outside door. When cargo rather than passengers is the objective, the rear seat can be removed, making an area of 42 cubic feet entirely clear for cargo.

Piper has continued to make maintenance an easy task and an innovation in the '53 *Tri-Pacer* is a large access door in the belly of the fuselage through which a mechanic can work on stabilizer mechanism, radio loop and controls. The cowling is easily removed, but I am wondering whether the cowling latch, with its Dzus fastener, will stand up under sustained operations.

The *Tri-Pacer* 135 and the *Pacer* 135 are offered by Piper in three basic models—Standard, Custom and Super Custom. The first includes flaps, metal propeller, and basic flight instruments. In the Custom are all equipment on the Standard, plus lights, cigarette lighter, sensitive altimeter, low frequency receiver, VHF transmitter, radio direction finder, radio shielding. The Super Custom has complete instrumentation, including artificial horizon and directional gyro, Narco Super Homer omni receiver, two-band LF receiver, VHF transmitter and receiver, and landing light.

This *Tri-Pacer* combines utility, comfort, speed, range and operating economy into a package well within the reach of almost anyone—from the small corporation or business to the sportsman. The Standard, flyaway Lock Haven, sells for $5,595.00; The Custom for $5,195.00; and The Super Custom for $7,105.00.

As a test pilot accustomed to much heavier and much faster aircraft, I like the *Tri-Pacer*; and I am sure that it will have the same appeal to everyone else who flies it. Its performance and flexibility utility make the *Tri-Pacer* a valuable tool in the realm of business.

TRANSPORTATION COSTS—*direct, indirect and per passenger-mile according to hours of utilization—of the Piper Tri-Pacer are shown here*

DIRECT COSTS

Gas and Oil 7.7 gal. per hour at average of 32¢ per gal. and 1 pint oil per hour @ 40¢ per qt.	$2.70
Inspection and Maintenance including 25 and 100 hour inspections plus parts and all other normal maintenance	.65
Engine Overhaul—Manufacturer's flat rate $612.00 @ 750 hours	.82
HOURLY DIRECT OPERATING COSTS	$4.17

INDIRECT COSTS

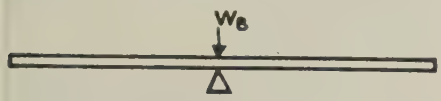
Hangar $20.00 per month average	$ 240.00
Insurance Public liability and property damage	94.00
Hull Insurance @ 7% for private pilot with 200 hours	420.00
Depreciation Allowable tax deduction 25%	1,500.00
ANNUAL FIXED COST	$2,254.00

ANNUAL HOURS FLOWN	300	400	500	600	700	800	900	1000
Hourly Direct Cost	$4.17	$4.17	$4.17	$4.17	$4.17	$4.17	$4.17	$4.17
Annual Cost per Hour	7.51	5.63	4.50	3.75	3.22	2.82	2.51	2.25
Total Hourly Cost	11.68	9.80	8.67	7.92	7.39	6.99	6.68	6.42
Cost per mi. @ 125 mph	9.3¢	7.8¢	6.9¢	6.3¢	5.9¢	5.6¢	5.3¢	5.1¢
COST PER PASSENGER MILE	2.33¢	1.95¢	1.73¢	1.57¢	1.47¢	1.40¢	1.32¢	1.27¢

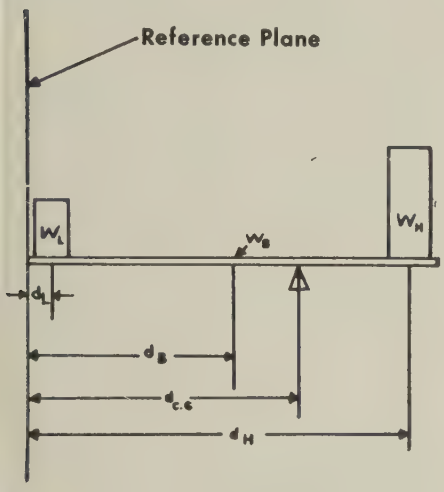
Weight & Balance Control

(*Continued from page 21*)

the board so the fulcrum is located at this point.



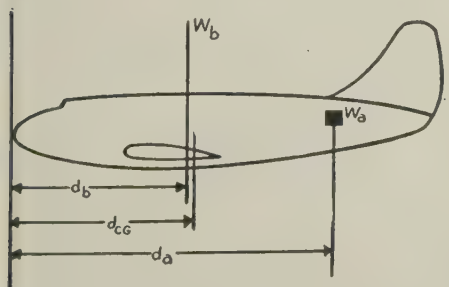
If a heavy weight (W_H) is placed on one end and a small weight (W_L) is placed on the other end, the fulcrum must be shifted toward the larger weight in order to make the combination balance. The point at which it will balance can be calculated by taking moments about any convenient point.



$$W_B \times d_B = (Wd)_B$$
$$W_L \times d_L = (Wd)_L$$
$$W_H \times d_H = (Wd)_H$$
$$\overline{W_{total}} \qquad \overline{(Wd)_{total}}$$
$$\frac{(Wd)\ total}{W\ total} = d_{c.g.}$$

The balance calculations for an airplane are handled in the same way. The gross weight of the airplane is the sum of the weights of the items in the airplane. The center of gravity of the complete airplane can be calculated by obtaining the sum of the moments of the individual items, about a common reference point, and dividing this total moment by the total weight.

The movement of the center of gravity with the addition, deletion, or relocation of any item can be calculated just as in the case of the see saw.



W_b = Weight Basic Airplane
W_a = Weight of Item Added
W_r = Revised Basic Weight

d_b = Distance from Ref. Plane to Basic C.G.
d_a = Distance from Ref. Plane to Item Added
$d_{c.g.}$ = Distance from Ref. Plane to Revised C.G.

$$W_b \times d_b = (Wd)_b$$
$$Wa \times d_a = (Wd)a$$
$$\overline{W_r} \qquad \overline{(Wd)_{total}}$$
$$\frac{(Wd)\ total}{W_r} = d_{c.g.}$$

The weight and balance control by the manufacturer is many-sided and will only be briefly outlined at this time. This phase of weight and balance work uses a great many more manhours than the other two stages. Some companies employ more than two hundred men in the Weight and Balance Sections of their Engr. Depts.

The work of these engineers starts with the first steps of design, when the information available may be no more than a list of the basic requirements for the airplane and a rough three-view drawing. At this time the Weights Engineer makes his first weight calculation based on curves, formulae and charts. The first approximation of the weight allows the other designers to determine wing and tail areas, wheel and brake sizes, powerplant requirements, etc.

With this additional data a more refined and a more detailed weight estimate can be prepared and a preliminary balance can be run. This data can be used by the Structural Engineers in determining preliminary sizes for the main load-carrying members and by the layout men in locating the major components of the aircraft.

At this stage of the design enough information may be available to permit the design to be considered "frozen". Guaranteed performance is issued, major areas and dimensions are finalized, powerplant items are picked and the design gross weight and design CG locations are determined.

Once the design is "frozen" and moves from the preliminary design stage to detail design stage, the Weight Engineer's job shifts from estimating to detail calculation of all parts proposed and drawn to insure weights and CG's are maintained.

The manufacturer's Weight Group must also prepare data to be used by the customer in the operation of the aircraft. On military aircraft this is in the form of loading charts and data to be used in preparing a weight-and-balance slide rule. For small aircraft it is in the form of loading tables for the Pilot's Operating Handbook or a simple placard such as "Fly Solo from Rear Seat Only". For the larger cargo or passenger-type aircraft, it may take the form of charts or curves. One type of curve is known as a "Potato Diagram" in which you plot weight vs. CG location for all limiting conditions.

To prepare a "Potato Diagram" for any aircraft, first plot the weight and CG of the Operating Weight Empty. Then step by step

(*Continued on page 56*)

GENUINE
NAVY INTERMEDIATE PILOT JACKET

SPECIAL!
$32.50
—FOR A LIMITED TIME ONLY. Shipped postpaid if remittance accompanies order.

U.S.N. ISSUE

Brand new. Genuine dark brown Goatskin leather with zippered front, Bi-swing back, two patch pockets, one inside snap pocket, Mouton fur collar, Celanese lined. 100% wool cuffs and waist band.

FINEST JACKET MADE
Sizes 34 to 50—State Size Wanted
FLYING EQUIPMENT SALES CO.
Dept. S
1639-45 W. Wolfram St. Chicago, Ill.

UNLIMITED OPPORTUNITIES IN
AERONAUTICAL ENGINEERING
DEGREE IN 27 MONTHS
Accelerated Course. Personalized, practical instruction. Wind tunnel, structural and dynamometer testing included. Bachelor of Science Degree courses also in Mech., Civil, Elect., Chem., Radio (Telev.) Engineering; Bus. Adm., Acct. Beautiful campus. Well equipped, modern buildings and labs. World-wide enrollment. Established 1884. Prep. courses. Low cost. Placement service. Growing shortage of engineers. Prepare now in shortest possible time for the opportunities ahead. Approved for Korean vets. Enter Sept., Jan., March, June. Write for catalog.

TRI-STATE COLLEGE
823 College Ave. ANGOLA, INDIANA

INVEST IN
U.S. DEFENSE BONDS
NOW EVEN BETTER

Photo Credits

Pages 10, 11, 12—New Jersey Press; 16, 17—Western Roundup; 18, 19, 20—Don Downie; 24, 25—Raeburn; 26, 27—Levy-Shippman; 28—Levy; 31—Levy; 34, 35, 36, 38, 40, 42, 43—Raeburn; 44—Bolsey; 52—Western Roundup.

Weight & Balance Control

(*Continued from page 55*)

add items of load to the Weight Empty, starting with the most aft item of load and working forward until the airplane is completely loaded. As each step is calculated, the weight and CG are plotted on the diagram forming one side of the "Potato".

The second step is to again start with the Operating Weight Empty, but this time the items are added step by step starting with the most forward item of load and working aft until the airplane is again loaded.

With this diagram it may be seen if it is possible to load the aircraft outside of safe CG limits or above the maximum gross weight. If any limits are exceeded, steps must be taken to insure that these conditions will not be encountered in flight.

It may be necessary to limit cargo in certain compartments under certain passenger loads, or in extreme conditions it may be necessary to limit passenger seating.

The field operator or the repair and overhaul base may be called on for weight and balance work varying from the substitution of one make battery for the battery of another manufacturer to complete modification of a plane into an executive aircraft.

Starting with the simplest type of field weight-and-balance problem, we assume that the weight and balance records of your aircraft are complete and up-to-date. If the change in the aircraft consists of the addition or removal of a standard item listed in the applicable CAA Specification, the weight calculations would be handled on a standard Repair and Alteration Form.

Assume you have a Beech D-18 and wish to add two three-minute parachute flares. In CAA Aircraft Specification No. 765, these flares are listed as Item 402 under Interior Equipment. On the Repair and Alteration Form, the change would be described and then the calculations would be made to revise the Weight Empty.

$$W_o \times d_o = (Wd)_o$$
$$43 \times 261 = 11{,}223$$
$$\overline{W_R} \qquad \overline{(Wd)_R}$$
$$\frac{(Wd)_R}{W_R} = d_{c.g.}$$

Where W_o = the original Weight Empty from the airplane records
d_o = the arm to the c.g. based on the airplane records
W_R = the revised Weight Empty
$d_{c.g.}$ = the arm to the new center of gravity

If the change consists of the addition or removal of an item not listed in the Specification, it will be handled in much the same way as the first example, except the weight of the item and its location in the ship will have to be determined.

After the new Weight Empty and CG are determined, the limiting load conditions should be checked to insure that the maximum gross weight is not exceeded and that the most-forward and most-aft CG obtainable are within the allowable limits.

If the weight and balance records for the airplane are not up-to-date or are missing, the ship must be weighed to form a basis for future calculations.

When a major modification is to be undertaken, the weight problems parallel the work done by the manufacturer.

First, a check must be made of the approximate end product. The check should start with the weight and balance of the unmodified airplane, then account for the major items to be removed, the major items to be added and the major items to be relocated. With this approximate modified weight and center of gravity, a rough check should be made of possible loading conditions. How many pounds are available for Useful Load? Will the most-forward or most-aft CG limits be exceeded under normal flight loadings?

With this data the necessary changes can be made to insure that the revised plane will be usable for the desired job. This preliminary weight-and-balance check may show that the maximum gross weight condition is not a limiting factor but that only a small amount of baggage can be carried in a rear compartment due to an aft CG condition. In this early stage of redesign, it is often possible to rearrange equipment to achieve a more efficient design; for example, it might be possible to move the galley from the aft to the forward portion of the cabin, leaving a much greater baggage allowance in the aft hold.

As in the case of the manufacturer, once the design has been frozen a constant check of the weight and balance must be maintained. Items which are removed are weighed and their location noted. Weight of items to be installed are calculated, weighed, or their actual weight obtained from catalogs. Each year more and more of the catalogs of the accessory manufacturers are including their product weights, but the best source for this data is the "Weight Handbook," published by the Society of Aeronautical Weight Engineers.

From time to time during the modification, a complete check of weight and balance should be made using the latest information available. From these checks it may be apparent that the desired results are not being achieved—perhaps the weight is greater than expected. A decision must then be made whether to change the design to lighten the ship or reduce the payload. Perhaps the center of gravity is moving too far forward or aft. Studies can be made to find what items can be relocated. Batteries with their high density are the favorite items to shift. Perhaps it is not feasible to shift any items at this stage in the modification, then studies must be made to determine what limitations must be placed on the loading of the aircraft. In some airplanes it has been necessary to remove the rear row of seats.

There is also the problem of getting the actual weight of the complete airplane. There are many different makes of weighing devices, the main types being spring scales or dynamometers, lever scales, hydraulic scales, and electric scales. A built-in lever scale installation with a rigid base gives very accurate results. The Electric Weighing Kit has provided the first really portable weighing device which can be used to weigh large aircraft.

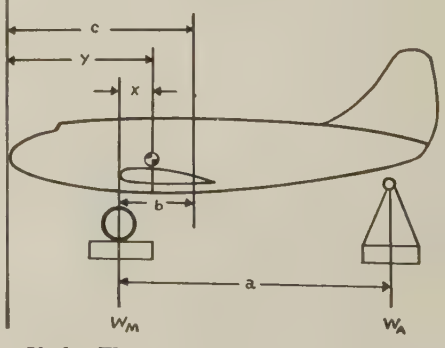
To get an accurate weight, the airplane must be weighed in a closed building. If heating or ventilating ducts in the hangar are located so that they direct a blast of air on the ship, these systems should be shut off during the weighing operation. A blast of air may only change the weight of the airplane 20 or 30 pounds, but if this force is applied to the horizontal tail surfaces, it can make an appreciable error in the center of gravity location.

When the airplane is weighed, it should be as close to its operational Weight Empty as possible. All cowlings, access doors, etc., should be in place; hydraulic systems should be filled to operating level; lubricating oil tanks should be filled to normal level; galley and lavatory tanks should be filled; and all cabin furnishings should be installed.

The fuel system should be drained for the most accurate results, but if this is not possible, fill the fuel tanks to capacity. Never try to weigh an airplane with partially filled fuel tanks. If the tanks contain fuel at the time of weighing, the density of the fuel must be determined in order to correct the "as weighed" weight to a "basic" weight condition. The density of the fuel can be determined with a hydrometer or by weighing a sample of the fuel in an accurately calibrated container.

The capacity of the tanks and the arm to the CG of the fuel in the tanks can be found in the CAA Specification.

The normal procedure for weighing an airplane is to mount the airplane in the flight attitude with the centerline of the fuselage level. A scale is placed under each of the wheels or support points and the scale reactions recorded. While the airplane is in this position, measurements "a" and "b" are taken to tie scale reactions into the datum point.



If the Electric Weighing Units are used in the weighing, the capsules are mounted between the jack points on the airplane

(*Continued on page 58*)

The 1952
Aircraft
Year Book

Official Publication of the
Aircraft Industries Association
is now available

Assure Prompt Delivery By Ordering NOW!

FOR 34 YEARS THE STANDARD REFERENCE
OF UNITED STATES AVIATION

- ***More than 300 American airplanes described in detail—photographs and three-view scale drawings.***
- ***Historic planes and the finest chronology af aviation events ever published.***
- ***Complete current official aviation records, the men and the machines, dates and places, precise figures.***
- ***A complete review of developments in the Armed Services, the aircraft industry and the airlines.***
- ***Thumbnail biographies of 1,200 present-day aviation personalities.***
- ***Complete current bibliography of aviation books.***
- ***Outstanding technical developments in the design, manufacturing and research fields.***

ORDER NOW **$6 a copy**

The LINCOLN PRESS, INC.
Publishers, The Aircraft Year Book
511 11th St., N.W., Washington 4, D.C.

PLEASE SEND ME——— COPIES OF THE AIRCRAFT YEAR BOOK

Name

Street

City **Zone** **State**

——— **Check**

——— **Money Order**

BE A UNITED
PILOT

Applications Now Being Accepted For 1953 Training Classes

Have a career in commercial aviation with one of the nation's leading airlines. Pay is excellent, and there are ample opportunities for advancement. Retirement-Income Plan, broad Insurance Program and many more benefits.

QUALIFICATIONS:

Age: 21 to 30
Height: 5'6" to 6'3"
Vision: 20/20 without correction
Education: High School graduate
Citizenship: Must be U. S. citizen
Flying Experience: Must have valid CAA commercial license and first consideration will be given applicants who also possess instrument ratings.

Apply now to:

UNITED AIR LINES

Write C. M. Urbach, Dept. S
United Air Lines Operating Base
Stapleton Field, Denver 7, Colorado

SKYWAYS Subscribers IF YOU MOVE . . .

Send change of address to Henry Publishing Company, 444 Madison Avenue, New York 22, N. Y., at least six weeks before the date of the issue with which it is to take effect. Send old address with the new, and if possible send your address label. Copies will not be forwarded by the postal service unless you supply the necessary extra postage.

ENGINEERING DEGREE IN 27 MONTHS

INDIANA TECHNICAL COLLEGE

B.S. DEGREE. Aeronautical, Chemical, Civil, Electrical, Mechanical and Radio Engineering (inc. TV and Electronics). Drafting, 1-yr. G.I. Gov't approved. Low rate. Earn board. Large industrial center. Students from 48 states, 21 countries. Demand for graduates. Enter Mar., June, Sept., Dec. Catalog. 223 E. Washington Blvd., Fort Wayne 2, Indiana.

Weight & Balance Control

(*Continued from page 56*)

and a jack capable of supporting the weight of the airplane. The airplane is raised, by means of jacks, into the level position.

Measurements are then taken to tie the reactions into the datum point. The calculations to obtain the CG from the scale reactions and the measurements taken at the time of weighing are as follows:

Taking moments about the centerline of the main wheels:

$$W_M \times O = O$$

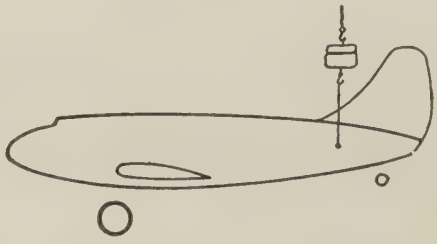
$$\frac{W_A}{W_T} \times a = \frac{M_A}{M_T}$$

M_T = x the distance from the main wheels

W_T to the CG

$c - b^2$ = distance from datum to centerline of main wheels.

$Y = c - b + x$ = distance from datum to center line of main wheels.



Either the manufacturer of the airplane or the shop that modifies an airplane to meet a customer's special requirements must supply the pilot with data with which to compute his weight and balance for any normal type of loading. This data may be in the form of charts, curves, tables or some form of balance computor.

The slide-rule type of computor is well known to the pilot with Air Force background. Since early in the war all military aircraft except trainers and fighter planes have been equipped with this type of balance computor. These computors can be obtained to match the custom interiors of executive airplanes.

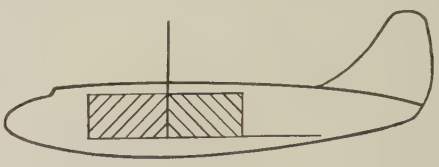
For each variable load item a scale is provided on the slide rule so that the final balance can be quickly determined.

Where a number of ships of the same type are operated between fixed bases, it is often possible to save loading time by providing loading tables for use at all terminals. These tables will list which cargo compartments are to be used when a given combination of passengers and freight are to be carried.

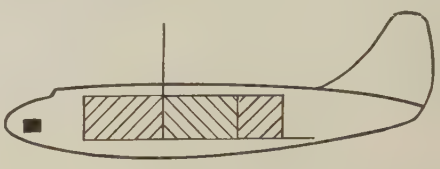
It is difficult to provide a short-cut method for computing the balance of cargo-type airplanes since their loadings are so unpredictable. If the cargo consists of relatively small items, the ship could be divided into compartments and the loading totalled for each compartment. Assuming the centroid of the compartment as the CG of the load, with this breakdown of load a balance slide rule or charts can be used to figure the airplane center of gravity. However, if the load is made up of a few large items spread over several compartments, it is difficult to get an accurate balance with either charts or the slide rule.

The operator of cargo-type airplanes runs into the most varied types of loadings. Some loads may have a low-density cargo where space is the major consideration. Other loads may be of extremely high-density cargo where overloading of certain compartments may be the determining factor.

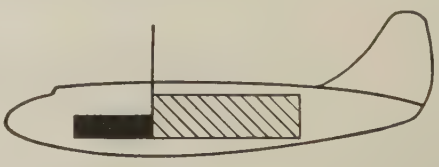
Under some conditions of low-density cargo, it may not be possible to fill all the available space, due to a lack of weight in the balancing portion of the load.



Under a condition of this sort, it is conceivable that a greater cargo load could be carried if high-density ballast were added in the forward portion of the airplane to balance additional low-density cargo in the aft part of the airplane



Or under a condition of this sort if the load consists of both high and low-density items, the high-density items might be loaded forward to balance a large volume of low-density items aft.



Different operators have developed systems to assist and speed the loading of their aircraft. One system might be to paint the outline (to scale) of the cargo compartment of a ship on a table. Then the various loads could be drawn on the table with chalk and from this layout the balance can be computed. Any shifting of load necessary to bring the airplane in balance can be done before the cargo is placed in the ship.

Another method is to paint the outline of the cargo compartment on the hangar floor or the ramp. Then the actual cargo can be put in position and the balance computed. These systems can be refined to include the location of the tie-down fittings so that the relation of cargo items to these fittings will be known before placing the load in the ship.

Not all loads can be computed at a home base where these layouts of load can be made, so provisions for in-the-field loadings are necessary. The slide rule is the quickest and easiest method of obtaining the balance, only falling down when large items must be handled. Here loading forms plus charts of variable load items are needed.

Navigation NAVICOM Communication

Vol. 12 Number 2 February, 1953 Navicom Number 20

GCA Goes On Trial This Winter

Operations in high-density areas to be carefully watched by public

American civil aviation enters the winter of 1952-53 burdened with the knowledge that the general public will be watching with a critical eye for any breakdown in the much-publicized "safety advancements" which followed the fantastically bad luck of last winter. "Preferential" runway systems, re-location of instrument approaches, etc., have not dispelled the awareness of the obvious fact that one bad accident in a metropolitan area will revive public clamor for closure of the industry's most needed airports.

Sharing the burden with the above changes, will be that latest "whipping boy" of navigational and approach aids, Radar. Cold statistics cannot possibly reflect the amazing increase in the traffic density in the metropolitan terminal areas. No other subject is giving as many nightmares to industry and government experts as the possibility of two high-density super-large airliners tangling over a major city and splattering a hundred tons of assorted airplane scrap metal over a couple of square miles of protesting populace!

Hence, with improved, new instrument runways and approaches, circuitous approach and departure patterns, increased crosswind components, the need for greater and more efficient use of the available airspace and runways calls for increased use of Radar.

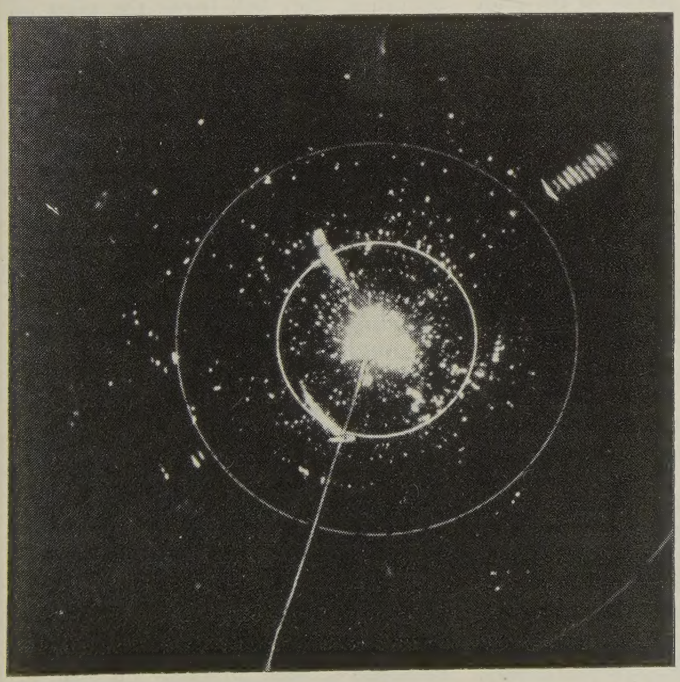
Associated since its inception with instrument approaches, Radar or GCA (Ground Controlled Approach) will be relied on more heavily than before to safeguard reduced intervals between landing aircraft. To reduce these intervals below standards acceptable without radar, assurance must be given that radar will always be able to observe the targets of successively approaching aircraft, identify them, confirm the pilots' position reports and initiate corrective action when the minimum of separation becomes jeopardized.

Airline pilots and pilots of airline-type executive aircraft operating IFR into these terminals are familiar with both the fully ground controlled "GCA" approach and the "monitored" approach where the pilot entirely controls his approach while Radar "advises" him as to the progress and accuracy of his effort. The latter, for reasons of understandable pilot preference (or prejudice, if you prefer) is by far the more common system. In fact, the necessity for the pilot to place himself inbound over the "gate" fix from a commonly shared holding pattern precludes the time consuming "identifying" search procedure usually associated with GCA approaches in the flying public's mind. (And hence, the inadvisability of any inadequately equipped and comparatively inexperienced pilot presenting himself in such an area, relying solely on the availability of GCA to accomplish his safe arrival!)

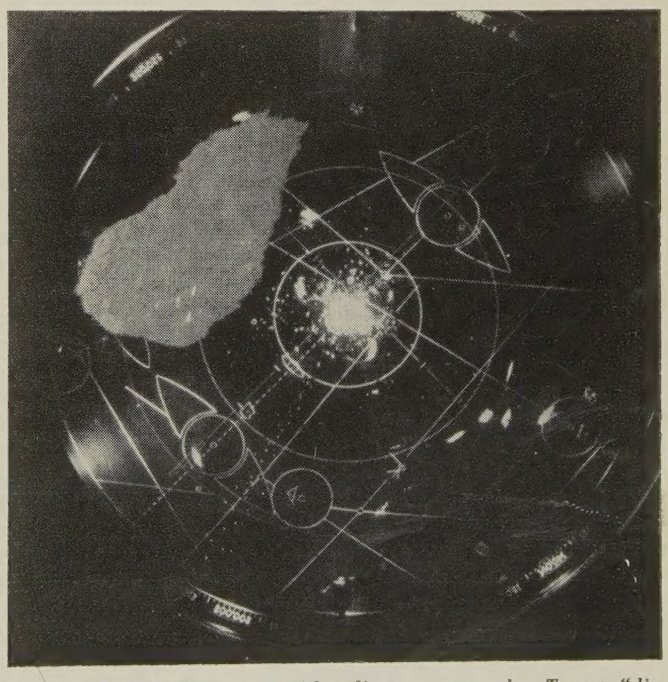
For some time, one of the greatest deficiencies in the use of radar as a civil navigation and approach aid has been the problem of identification. With congested areas and the time element prohibiting old-style identification maneuvers, reliance has been placed on pilot position-reporting coincident with observed targets over the "gate" fix.

Much concern has arisen throughout the country over the increased number of incidents involving mis-identification

(Continued on page 62)



RADAR SCREEN *(without map overlay) shows two moving targets (with comet-like tails), one pierced by simulated VHF/DF identifying tracer*



RADAR SCREEN *shown here with radio-nav map overlay. Targets "disappear" in simulated storm area (upper left side) of heavy rain*

GCA On Trial This Winter?

(*Continued from page 61*)

due to erroneous or premature indications of cockpit instrumentation. With shorter intervals, aircraft reporting "late" over approach fixes behind slower preceding aircraft reporting "early", have actually passed enroute and "broken out" on final in reverse order!

The great white hope has been the promised introduction of airborne radar beacons flashing coded signals on the radar screen to identify the respective aircraft on approach. The fly in this ointment to date is that experiments have demonstrated that these "transponders" will respond under certain conditions to any of the several transmitters in range, destroying their usefulness in the very congested areas where they are most needed!

To reduce the interval to a predetermined separation and maintain it, all aircraft targets involved must be continuously observable to the radar controller. It is commonly known that present-day equipment fails critically in this respect when moderate to heavy rain or snow are present along the approach path. This has been a greater problem with approaches because of the restricted path that must be adhered to. Targets have emerged from such "precip" areas with less than satisfactory separation from preceding aircraft; and with succeeding aircraft only three minutes behind, there isn't much tolerance for a delaying "360°" turn, taking two of those precious three minutes!

Aircraft departing IFR have benefited considerably from the reduced separation permitted with Radar Departure Control. Here, precipitation areas can be steered around at the discretion of the controller, where area congestion does not preclude deviation from a prescribed exact routing. However, in many instances it has been found that necessarily closely defined routings after take-off compel flight through certain areas in which very unsatisfactory radar returns are encountered, known as "blind spots". For this reason, it has been necessary to burden the operation with the necessity of additionally maintaining altitude separation, to a certain extent cancelling the advantages of radar control.

Civilian radar controllers are still bemoaning the lack of VHF/DF (VHF Direction Finding). Chicago is outstanding in having had this equipment for several years, whereas it is otherwise available only at installations used by military aircraft. By employment of this device, most of the doubt as to location and identification of a specific aircraft is resolved.

In operation, when the aircraft in question transmits, the VHF/DF imposes a line on the radar screen through the target and thus assists the controller in identifying or confirming the reported position of the aircraft. With proper relative positioning of the VHF/DF equipment to the approach "gate" fix, little ambiguity exists except in the case of simultaneous transmissions by two or more aircraft which necessitates a repeat transmission from the approach aircraft anyway.

An additional shortcoming in the use of radar to safeguard this winter's operations is the lack of adequate elevation or altitude detection equipment. With the exception of the comparatively short (10 miles) range of the Precision Approach elevation scope and its limited azimuth scan of approximately 15°, the controllers have no means of measuring the altitude of conflicting targets throughout the other 350° that they scan. This has been a source of irritation to many pilots who, on receipt of information that a target is converging in marginal or slightly better visibility, have taken diversionary action only to learn that several thousands of feet of altitude separated them from the uncontrolled aircraft. The military have the equipment necessary to do this, but civil airports lack it.

GCA not Limited to Emergency

Corporation and executive pilots making instrument approaches at terminal areas served by radar should understand two things about the available service that apparently are not as clear as should be. First, the use of GCA as a primary approach aid to the instrument runway does not imply a situation of emergency. Civil GCA is available, as is the ILS, to be used, and there is no reflection on the ability of the pilot who elects to use it in lieu of any of the other approved approach systems, ILS, ADF, LF range, VOR, etc.

Presuming that the pilot competently enters the area in accordance with the air traffic clearance given him, holds if necessary and descends in the holding pattern promptly as instructed, and proceeds accurately over the approach gate fix when cleared, the problem of identification is solved without additional time-consuming maneuvers. The execution of a simple, accurate instrument approach is usually assured. It is generally assumed that the pilot will continue to employ the facilities of ILS, ADF, etc., if he has them, to double-check on the accuracy of the controller's GCA instructions. There is a growing school of thought among some pilots that this is by far the easier method of approach.

He should also understand that generally the only approved GCA approach is to the instrument runway possessing all the other radio and visual approach aids, Hi-Intensity lighting, etc. Approaches to other runways employing the less accurate Search scope and without these additional aids are conducted in emergency only and during VFR Weather, for practice.

Secondly, the pilot should be aware that virtually all instrument approaches at these locations are "monitored". That is, the radar controller must watch every approach and be prepared to step in with "advisory" information in the event that the conduct of the approach at any time seems to be in jeopardy. Inasmuch as the pilot currently must request routine "GCA advisories" to be given during his approach, he will not likely hear anything from the GCA controller until and if he begins to get into trouble. Therefore, it is advisable that if a pilot wants this service to back up his personally flown operation, he should indicate this desire prior to starting the actual approach.

Monitoring for Safety

Now comes the hitch. Many pilots aren't too happy when they think of being "monitored" during an instrument approach. A few have been called in for an interview by CAA Safety Agents after a particularly questionable approach, or for no immediately apparent reason. The pilot impression has thus grown that either the GCA controllers are tattle-tales or that somebody is doing a little spying on the side.

The fact is, that when reported weather goes below approach minimums during an instrument day, or some other circumstance dictates, CAA Safety Agents do check the recordings which are made of all CAA transmissions including GCA, and when they come across one that indicates a questionable operation, they will invite the pilot in for a little discussion.

A particularly erratic approach might have resulted from some cockpit distraction or instrument failure at a very critical moment, exceedingly rough air or shifting winds, variables entirely outside the control of the pilot. Or, the Weather Bureau might report "below limits" weather during a variable condition when a pilot has just sighted the runway and quite naturally completes a landing. Or, due to conditions known only to the pilot, an approach might be missed under ostensibly favorable weather when all other approaches are being made good.

The pilot who competently employs all the instrument approach facilities and aids at his disposal, including GCA or Radar Advisories, has nothing to fear from an inquiry of this sort. Therefore, it should not deter him from accepting these aids. The pilot who is careless about his IFR navigation and approach techniques, and privately boasts of sweating out illegal descents below minimums to "get in", can take fair warning.

Nav-Aids Changes

ALMA, Ga.—VOR relocated near the intersection of runways.

BATON ROUGE, La.—New ILS commissioned on 110.3 mc, identifying "BTR," serving Runway 13. Outer Marker Compass Locator (LOM) on 284 kc, 4.31 miles from the runway; Middle Marker Comlo (LMM) on 236 kc at .62 miles.

CHARLESTON, W. Va.—New VOR on 113.7 mc commissioned. Distance and bearing to field, 11.6 miles on track of 61°.

CHICAGO, Ill.—MIDWAY Outer Comlo moved back to 6.5 miles from end of ILS runway.

CLEVELAND, Ohio—VOR to resume operation halfway between Elyria marker and field, just south of West course on CLE.

GREENVILLE, S. C.—Change of South course of LF range to 002° inbound eliminates the dog-leg in this approach and avoids flight directly over Donaldson Air Force Base.

KEY WEST, Fla.—CAA Communications Station moving to civilian Meacham Field from Navy's Boca Chica, simultaneous with commissioning of combined tower and Insac.

KNOXVILLE, Tenn. — Military VHF/DF installed, available on request on all standard civil frequencies.

MACON, Ga.—Combined tower and communications station slated.

NEW YORK, N. Y.—Idlewild Departure Control will start on 121.1 mc as soon as this frequency is out of all local small towers. Air Route Center using 125.1 mc instead of 126.5 mc given up to Newark Approach Control (see page 00). Newark also will get 121.7 for departures.

ORLANDO, Fla.—Approach Control for this location may be handled by nearby Pinecastle AFB due to greater amount of IFR traffic.

PITTSBURGH, Pa.—Greater Pittsburgh E-W runway redesignated 10-28.

SAN ANTONIO, Tex.—Center frequency 120.3 mc replaced by 120.1 mc.

ST. LOUIS, Mo.—Center frequency 118.9 mc replaced by 120.3 mc.

TAMPA, Fla.—Approach Control may never see the new tower if plans for IFR room and control at nearby military field are effected.

TORONTO, Ont.—Outer Comlo commissioned on 341 kc, identifying "Y" at the Outer Marker site serving Runway 10.

WASHINGTON, D. C.—Mt. Vernon radio beacon on 203 kc decommissioned. Charlotte Hall radio beacon has had a VHF marker added, identifying "— —," on SE course of Andrews.

Low-Level IFR Altitudes Used for Short-Haul Operation

How many times have you filed a bottom IFR minimum altitude for a flight of 100 miles or thereabouts, and if you didn't wait an hour for a break in the enroute, long-range flights along the desired airway, you were probably offered a ridiculously high and impractical altitude and circuitous route to leap-frog over crossing-airway traffic?

If a plan now afoot works out well in service test, the above situation may soon be a nightmare of the past. Subject to pilot and ATC acceptance in actual operation, altitudes of 4,000 feet and below between adjacent Approach Control airports may be reserved for just such use, eliminating much of the common nuisance as well as freeing the Air Route Centers for full attention to the long-range traffic.

Examples of this would be flights between Philadelphia, Reading, Wilmington and Baltimore. Or, Elmira, Binghamton and Ithaca where approximately 100 flights daily tie the New York, Boston and Cleveland Centers in knots over coordinating a 40 to 50 mile triangle of local traffic.

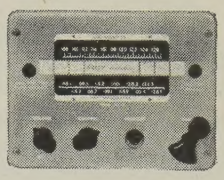
Washington—Baltimore—Richmond, and Newark—Idlewild—LaGuardia—Westchester—Teterboro have done some of this informal cooperative clearances at low altitude for some time.

If this plan is adopted, the 5,000 foot altitude would be used for "transition" to the higher enroute altitudes of 6,000 feet and above.

Lear Offers Guide to ADF Radio Compass Stations

Lear Inc. has brought out a concise and convenient guide to more than 2500 radio stations located throughout the U.S. suitable for Automatic Direction Finding. Homstation designations are given, the type, the frequencies, power, the kind of antenna, etc. Booklet sells for $1.00, but it's worth a lot more.

SIMPLEXER



2-way VHF communications system cuts pilot strain because it's...

Twice as Easy to Use!

First because the 12 channel transmitter lets you avoid the usually crowded general tower frequencies. You select the exact frequency assigned to the tower—and talk without waiting.

Second because you tune without watching the dial. *Just pull, crank, push.* The crystal calibrated whistle tells you that you are on the right frequency. You are safer—because you can keep your eyes on air traffic, not on the radio.

Plus sensitivity and clarity that is absolutely amazing. The SIMPLEXER reaches out and gets the distant stations... provides you with complete local weather information for the entire course.

Weighs less than 4 pounds. Fits any panel, because it is only 6" deep. Use it alone, or combine it with any other radio equipment. But, for safety's sake, get a SIMPLEXER.

Like all Narco flight proven products, the SIMPLEXER is sold and serviced from coast to coast. See your Narco dealer, or write for the data sheet that gives the technical facts behind SIMPLEXER's superiority.

MODERN PANEL DESIGN

SIMPLEX TUNING

CRYSTAL CONTROLLED TRANSMITTER

NATIONAL AERONAUTICAL CORP.

narco AMBLER 5, PA.

Newark ILS & ADF Approaches Approved

Effective with the commissioning date of the Newark ILS serving the new instrument Runway #4, the following data governs the two respective approaches. Frequency 110.3 mc. Identifying "EWR."

ILS—Final approach heading, 037°. Procedure turn East side of SW course, minimum altitude 1500 ft. Minimum altitude at Glide Path interception, 1500 ft.; altitude over Outer Marker, 1500 ft., over Middle Marker, 245 ft.; distance to end of runway respectively, 5.6 miles and .66 miles. Minimums:—Regular (Circling) 600-ft. ceiling and 1½ miles visibility (except aircraft of stall speed 75 mph or less—600 ft. and 1 mile). Straight-in Approach to Runway 4: 400 ft. and ¾ miles. Alternate: 800 ft. and 2 miles. Take-off: 300 ft. and 1 mile. Missed Approach: climb to 1,000 ft. on NE course of the ILS, make climbing left turn, climb to 2,000 ft. on direct course to Paterson unless otherwise instructed by ATC. Transitions to ILS from New Brunswick and Matawan direct 80° and 356° respectively at 1500 ft.

ADF—Frequency of LOM 400 kc. Identification "EW." (CAUTION: reports of interference from Idlewild LF range of 379 kc!) Transitions from all fixes in area at 1500 ft., except Paterson and Chatham at 2,000 ft. Final approach course 037°. Procedure turn on East side of track; minimum altitudes at distances from LOM: SW 10 miles—1500 ft.; 14 miles—1500 ft.; 20 miles to 25 miles—1700 ft. Minimum altitude over LOM on final, 1,040 ft., distance to runway, 5.6 miles. Minimums: Regular, 600 ft. and 1½ miles (except aircraft of stall speeds 75 mph or less—600 ft. and 1 mile). Straight-in Approach to Runway 4: 600 ft. and 1 mile. Alternate: 1,000 ft. and 2 miles. Take-off: 300 ft. and 1 mile. Missed Approach: Climb to 1,000 ft. on track of 037°, make climbing left turn, proceed direct Paterson radio beacon at 2,000 ft., or as directed by ATC.

UNICOM Station List

NARCO, makers of the majority of UNICOM Ground Station equipment, has come out with a list of the airports offering this service. Obtainable through your nearest radio service and sales outlet, or possibly just posted on your local airport bulletin board, this list should be valuable to every pilot whose business takes him off airways and into non-control airports.

Maybe it would be a good idea if the Weather Bureau offices had this facility? Imagine being able to talk directly to the observer or forecaster, exchanging immediate, actual weather information without the necessity of cumbersome second-hand relay through range station personnel or landing at fee-charging busy terminal airports.

VAR to VOR Delayed

Further delay in plans for completing the program of replacing all VAR ranges throughout the country by VOR's has been incurred by a source which is no surprise to pilots of executive aircraft. While the government accelerated its plans to accomplish the elimination of Low Frequency and VAR ranges and pilots of executive and corporation aircraft hustled to equip themselves with the required new equipment, the scheduled airlines dragged their feet. As a result, due to the fact that the airlines are not uniformly ready, such VAR's as Matawan and Islip on the East Coast will remain in operation.

Area Problems Studied

A team of experts from the Technical Development and Evaluation Center at Indianapolis, Indiana, is now traveling the country making personal on-the-spot surveys of special area problems with an eye to recommending navigational facilities, procedures and techniques to help unsnarl the well-known knots in these areas.

After viewing the problem first-hand and gathering as much data as possible, their findings will be worked into a simulator back at Indianapolis. The problems then will be hashed over and studied with the advantages of a detachment and freedom to accelerate or decelerate the problem that can never be achieved on the actual scene in the course of everyday operations. In areas like Chicago and New York, both pilots and ATC people are too busy just trying to keep up with the ever-increasing traffic to be able to sit back and analyze their all-to-familiar problems.

Inasmuch as efficiency and safety are interwoven, it is hoped that the results of this technique will not only reveal how to handle more traffic more easily but will also increase the safety quotient.

New Radio and Electronics Service Base on East Coast

One of the greatest needs in the non-airline flying industry these days has been the difficulty of obtaining high standard radio and electronics maintenance. With the added complexity of airways and high density terminal area instrument weather techniques, the possession of topnotch communications and navigational equipment is about the most important requirement of safe and efficient flight movements.

The best radio is no good if it can't be kept in proper working order. Both installation and good maintenance has been a problem because the comparatively few radio and electronics service and maintenance outlets on the East Coast have been overloaded with backlogs of contracted and spot maintenance.

When this equipment goes out in an airplane used for business or corporation purposes, the resumption of immediate service is as necessary to the operation as would be engine maintenance. It is, therefore, good news that Airline Service, Inc., an organization that has acquired an excellent reputation for its service on the West Coast, at Seattle, Wash., has now announced the opening of a similar service base at Friendship Airport, Baltimore, Md.

Premature ADF Reversals are Traced to Antennas

Northeast Airlines, large New England scheduled operator, has been bothered for some time with reported premature ADF reversals, which has hampered instrument operations both cross-country and for instrument approach purposes.

For the information of other operators of large equipment, Northeast's maintenance department, in cooperation with government experts, has traced the cause to antenna installation characteristics which were common to Northeast's entire fleet. Appropriate changes were made and it appears that the trouble is satisfactorily cleared up.

This should be useful information to any crews experiencing this very annoying and critical situation.

PRINTED IN THE U. S. A. BY THE CUNEO PRESS, INC.